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## Competition

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### Glossary

dt0010

**Basal levels** Baseline or resting state levels of hormones.

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**Behavioral economics** A field of research interested in economic decision making with an emphasis on whether to cooperate for collective gain or defect for individual gain.

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**Cortisol** A steroid hormone that is part of the physiological stress response that can also act as a behavioral inhibitor.

**Dominance** An aspect of personality characterized by a drive for attaining and maintaining high social status.

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**Moderator** A variable that controls the nature of the effect that an independent variable has on a dependent variable.

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**Status** An individual's position in a social hierarchy relative to other members of the hierarchy.

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**Testosterone** A steroid hormone that has masculinizing effects on an individual that can also influence behavior.

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## Competition

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Whether it is for a significant other, a promotion, or the admiration of peers, social competition dictates a large amount of human behavior. This article will provide a review of the scientific research on social competition in humans. We will discuss the social function of competition, dispositional dominance, and the underlying physiology that drives dominance behaviors, focusing on testosterone. To that end, we will discuss the dynamic relationship between testosterone, personality traits, situational forces, and cortisol. We will also discuss sex differences in competitive behaviors, and conclude with a discussion of the field of behavioral economics with an eye towards how this research has informed our understanding of competitive behaviors.

A large body of research has examined both human and nonhuman competition. Among many nonhuman species, competition takes the form of physical aggression between individuals or groups. This aggression is used to establish who is granted access to what resources, including food, territory, or mates. Even among humans, competition may take a violent and physically aggressive form. The establishment of territory, access to coveted resources, or religious conflict between countries and/or groups may lead to large scale conflict, such as war. Smaller scale interpersonal violence, such as physical beatings or homicides, may be born out of interpersonal competition over a highly coveted resource, for example two men fighting over the same woman. Across a number of species, including humans, males tend to be the primary perpetrators of aggressive competition. This may be due to patriarchal social structures, evolution disproportionately benefiting aggressive males, or the underlying biological mechanisms driving behavior. As discussed below, research suggests that it is a combination of all three.

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## The Social Function of Competition

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Across all species, individuals must compete for access to limited resources. Yet, rarely do individuals compete over every uneaten apple or available mate. Rather, competitions are used to establish a social hierarchy, and this hierarchy is the primary means by which limited resources are allocated throughout the group. High status, though risky to pursue, grants the individual increased access to limited group resources.

Unlike nonhuman animal species in which physical aggression is the primary form of competition, human competitions do not always involve violence or physical aggression. Instead, humans have multiple routes to obtain resources and establish status. These alternate, nonaggressive routes include eminence (i.e., status given as a result of high levels of achievement), birthright, knowledge or ability, prosocial behaviors, and social manipulation or coercion. Some of the more explicitly competitive, but nonaggressive, means to pursue and obtain high status include academic achievement, work promotions, elections, or athletic competitions.

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High status within the hierarchy gives an individual numerous benefits. For humans, high status grants the possessor the power to direct groups (i.e., leadership), control inner-group functioning, influence lower status group members, and gain privileged access to group resources. From an evolutionary perspective, competition exists to facilitate the perpetuation of those genetic lines that are most fit to reproduce. By competing for high status, the most able individuals are most likely to reproduce. By virtue of having high status, individuals who win social competitions are healthier, have better diets, less stress, are more likely to copulate, and their offspring are more likely to live to a reproductively viable age. In short, high status yields a life style that is generally more pleasant, healthier, and more productive, and thus is generally more desirable than a life of low status.

Research has shown that social competition develops at a young age, even during prepubescence. Children learn at an early age that there are both coercive and prosocial means for gaining status, and they learn to utilize both effectively. Even children who do not actively pursue high status clearly learn to recognize the behavioral strategies being utilized by their peers. Research shows that not only do children recognize different strategies, but they respond to them in different ways. Even amongst prepubescent children, coercive strategies tend to lead to less stable, more transient forms of high status, whereas

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prosocial strategies tend to lead to more long lasting and stable forms of status. As an example, a bully may use coercion to establish his/her dominance, but that is very tenuous. A more friendly and prosocial strategy, alternatively, is more likely to yield higher numbers of friends, increased popularity among peers, and thus a stable coalition of social support.

## s0020 **Dominance and Competition**

p0040 The drive to engage in social competition to move up the social hierarchy characterizes much interpersonal human behavior. 'Dominance' refers to this striving for attaining and maintaining high status. Within the realm of personality and social psychology, dominance is often conceptualized as a trait-like feature of a person's personality (i.e., it is an inherent, enduring, and relatively static aspect of an individual's social behavior). Dominance, as with other personality traits, varies between individuals, with some individuals exhibiting higher levels of dispositional dominance than others. Competition is a common behavioral outcome of a dispositionally dominant individual's striving for high status, and individuals high in dominance tend to succeed in achieving the high status positions they desire.

p0045 Dominance can be expressed interpersonally in a number of ways. Postural expansion, or carrying oneself to maximize one's perceived size, maintaining eye contact while speaking to another individual (whereas maintaining eye contact while listening to another individual is perceived to be nondominant), and lower rates of smiling among women (but not men) are some behavioral expressions of dominance. Dominant individuals also respond to perceived status threats with anger and aggression. High dominance has been characterized by actions such as spontaneously and eagerly engaging in interpersonal competition, establishing oneself as being in charge of a group, projecting competence regardless of actual ability, behaving assertive, and controlling the actions of others.

## s0025 **Dominance and Testosterone**

p0050 A great deal of social endocrinology work has explored the role of hormones in human social behaviors, and no hormone has been given greater attention than testosterone. Testosterone is an androgen, meaning it is a steroid hormone derived from cholesterol that has masculinizing effects on an individual. Testosterone is produced in both men and women by the gonads, adrenal glands, and within the brain, though due to the fact that the testes produce testosterone in much larger quantities than any other source, men tend to have roughly seven times as much testosterone as women. Despite the great difference in testosterone levels between men and women, relative testosterone levels within sex can have similar influences on social behaviors in both sexes. For instance, a woman high in testosterone relative to other women will behave similarly to a man high in testosterone relative to other men, even though the high testosterone woman's testosterone levels will be much lower than the high testosterone man's. Although all hormone levels are subject to fluctuations caused by a number of factors, basal (i.e., resting or baseline) steroid hormone levels have been found to stay relatively static over extended

periods of time, leading many researchers to treat basal testosterone as a trait-like factor. It is worth noting that the majority of research on testosterone and competitive behaviors has focused on males. The findings and effects discussed below are based primarily on research on males, but sex differences and effects among females are discussed in section '[Sex Differences in Competition](#).'

In nonhuman animal species, testosterone has been associated with rank in the social hierarchy in a variety of species (e.g., baboons, deer, mandrills, chimpanzees, ducks, possums, mice, rats, grouse, finches), although only when the social hierarchy is unstable (justification for this is provided below in our discussion of the challenge hypothesis). Testosterone has also been found to be positively correlated with dominance-related behaviors, such as aggression. Just as with nonhuman animals, research on humans has established that there is a positive correlation between basal testosterone levels and dominance. Research shows that testosterone correlates positively with many behavioral aspects of dominance, such as high self-regard, scores on personality questionnaires, reactions to competitive outcomes, and social dominance. Basal testosterone also correlates with increased sensitivity to status-relevant information, even when that information is presented outside of conscious awareness, and reacts by rising or falling as a result of engaging in socially competitive behaviors.

The link between testosterone and aggression deserves special mention. Popularly, testosterone is believed to cause increases in aggressive behavior, but this is not entirely true. Research suggests that testosterone promotes dominance behaviors, which can be manifested behaviorally in a number of ways. In terms of aggression, though, dominance will only manifest itself as physical aggression in social groups in which physical force is an acceptable and efficient means by which to compete for status (e.g., prison populations). Social norms dictate that physical aggression in the pursuit of status is a potentially costly behavioral strategy, with the possibility of incurring punishment for violating those norms (e.g., arrests for violent crimes). Even in those instances when testosterone leads to aggressive behavior, research has found that the effect tends to be moderated by neurobiological mechanisms related to low levels of impulse control (e.g., low frontal lobe activity, low levels of serotonin).

Although the human literature supports the idea that testosterone is linked to dominance, it is not the case that testosterone influences behavior in every situation. The challenge hypothesis postulates that testosterone will influence behavior only during critical periods to facilitate behavior during moments of high competition, such as mating seasons or during times of hierarchy instability. Although originally developed to explain the mating behaviors of birds, the challenge hypothesis has since been expanded to explain a wide range of testosterone-behavior relationships in a variety of species. Researchers have confirmed that humans' physiology and psychology interact in ways that are consistent with the challenge hypothesis.

The critical role of the situation, according to the challenge hypothesis, is that testosterone will not have an effect on behavior if the situation does not contain a status threat or an opportunity to increase status. Put another way,

if testosterone is the underlying biological force driving dominance-related behaviors, testosterone will not influence behavior if there are no dominance-related gains to be had. If the social hierarchy is firmly established, there is nothing to be gained; then any influence testosterone might have on behavior will disappear. It is when the hierarchy is unstable, and thus high status positions are available, that testosterone's influence over behavior will become apparent. This is in contrast to the 'mouse model' which portends a direct cause and effect relationship between testosterone and behavior across all situations.

p0075 In summary, research has established that basal testosterone strongly influences dominance behaviors in humans. Further, both humans' and nonhuman animals' behavior will only be influenced by testosterone in social environments in which it is possible for an individual to increase his/her status. This means that competition is generally only engaged in when there is something to be gained from competing. It is also the case that testosterone and dominance strongly interact with the outcome of those social interactions in which status is gained or denied. The successful attainment or denial of high status and overt threats to one's status has been found to carry powerful psychological and physiological consequences.

### s0030 Testosterone and Status Mismatches

p0080 The psychological motivations that drive an individual's desire for competition are deeply rooted in physiology, namely the testosterone circulating through their bloodstream. Given that this motivation is so deeply rooted, you would expect that successful attainment or the denial of high status would have dramatic consequences for a highly dominant individual. Research has found that success or failure when competing does elicit strong psychological and physiological reactions.

p0085 Researchers have found that when an individual engages in social competition, basal testosterone predicts a number of reactions to the successful attainment of high status or relegation to low status. If an individual is high in testosterone and experiences a victory, he/she will be content, indifferent to status-relevant information, report lower levels of negative emotional affect, and perform well on complex cognitive tasks. The opposite effect has been shown for high testosterone individuals who experience a loss. These high testosterone individuals show increased levels of negative affect, cognitive impairment, and an increased focus on status cues when relegated to low status positions.

p0090 Notably, this research has found opposite patterns of effects for those low in testosterone. Low testosterone individuals who experience a victory become unhappy, report high levels of distress, show cognitive impairment, and experience physiological arousal, such as increased heart rate. Those low testosterone individuals who lose a competition, though, report being quite content, perform very well on complex cognitive tasks, experience a drop in heart rate, and show a lack of interest in status-related information.

p0095 Termed the 'mismatch effect,' this illustrates the role of basal testosterone in social competition. Individuals high in basal testosterone have a strong desire for high status, whereas those with low basal testosterone levels actively avoid high status. When an individual is placed in a position of high or

low status that is incongruent with his/her desired status (i.e., a high testosterone individual in a low status position or a low testosterone individual in a high status position), they experience a number of negative consequences. A mismatch between actual status and desired status causes emotional distress, hypervigilance towards status-related information, physiological arousal, and a decline in complex cognitive processing. This mismatch effect also illustrates individual differences in dominance by demonstrating that not everyone is striving for positions of high status, that there are some who would prefer to avoid high status if at all possible. The adverse effects of status mismatches can also extend from the individual to the group level. If status mismatches exist among individuals within a given group, those mismatches are associated with greater pessimism among group members as to the likelihood of the group's success on a task. Also, as the correlation between individuals' testosterone and their status within a group becomes more negative (i.e., mismatches increase), the group as a whole functions more poorly.

It is clear that testosterone is intimately linked with dominance, and the successful attainment or denial of high status elicits strong reactions in dominant individuals. Winning or losing status competitions causes psychological and physiological reactions, and can lead to maladaptive behaviors. One strong reaction caused by the interaction of dominance and competitive outcomes is the short-term fluctuations in hormone levels that can further influence behavior. p0100

### Dynamic Testosterone Fluctuations in Competition

Although basal testosterone levels remain static over time and can be treated essentially as personality traits, testosterone levels are also subject to dynamic fluctuations in reaction to changes in the social environment. If basal testosterone is a biomarker of trait dominance, changes in testosterone levels are akin to a transient dominance mood state. A temporary rise in testosterone can lead to a temporary elevation in one's social competitive drive. Similarly, a temporary drop in testosterone can temporarily suppress one's natural competitive motivation. The reciprocal model of social endocrinology tackles the dynamic relationship between basal hormone levels, the environment, and transient hormone fluctuations. Specifically, hormones influence behavior, behavior influences the environment, changes in the environment cause temporary fluctuations in circulating hormone levels, and these temporary fluctuations in turn further influence behavior and the environment. Hormones, and certainly testosterone, act not only as partial causes of behavior, but also experience the effects of behavior. p0105

Research on testosterone and competition has found that testosterone rises in response to competitive environments. Many athletes experience a rise in testosterone prior to engaging in athletic competition to facilitate dominance behaviors in the competitive environment. Athletes' testosterone rises significantly more before a competition played at home than away, presumably because more status is on the line when a team plays at home, and that the rise tends to be the strongest when a team is competing against a serious rival. This suggests that not only does testosterone rise in anticipation of a competitive event, but that the degree of status threat moderates the magnitude of testosterone increase. p0110

p0115 A number of studies have also found that not only does testosterone increase in reaction to a competitive environment, but that it fluctuates in predictable ways in response to the outcome of a competition; specifically, testosterone increases following a victory and decreases following defeat. In fact, an individual does not even need to actually engage in competition to elicit these effects. An individual's testosterone follows this same pattern even when they experience a vicarious victory or defeat, such as an imagined victory, watching their political candidate win an election, or watching their sports team win a game.

p0120 These temporary fluctuations are an important signaling mechanism that prompts an appropriate behavioral response (i.e., rising levels prompting further engagement in competition, falling levels prompting withdrawal from competition). The temporary changes in testosterone following a loss influence how individuals choose to behaviorally react to that loss. They are either motivated to attempt to regain high status when testosterone increases or withdraw from the possible further loss of status when testosterone decreases.

p0125 Even though many researchers have found that testosterone levels change in reaction to the outcome of a competition, some research has failed to find this effect. Instead they found that testosterone changes following a competition were moderated by a number of psychological factors. For instance, in some group competitions, increases in testosterone are positively correlated with how much an individual contributes to his/her team's victory, such that the more a given individual was responsible for his/her team's victory, the more his/her testosterone will increase. It has also been found that changes in testosterone levels are negatively correlated among winners who attributed their victory to external factors (e.g., luck), and were positively correlated amongst losers who made the same external attributions. This suggests that simply engaging in competition is not enough, but that psychological factors, such as motivation and cognitive appraisals of the competitive situation, are what drive reactions to competitive outcomes.

p0130 Nonconscious motivational drives can also moderate the effect of competition on testosterone fluctuations. Namely, those who are high in implicit (i.e., nonconscious) power motivation show the expected hormonal reactions to winning or losing a contest. In this case, the competition-testosterone-change link is dependent on personality factors related to an unconscious desire for power and high status, not merely the experience of winning or losing. Some research has also found that some personality factors not even directly related to status and power can also influence the relationship between competition and testosterone change, such as social anxiety.

p0135 Even though previous research has clearly linked testosterone to status-seeking, there have been striking inconsistencies across studies. Although much of the research summarized above did indeed show effects of testosterone on behavior, other studies have found weak or null effects. One explanation is that testosterone's effect on behavior is moderated not only by psychological factors, but also by the hormone cortisol.

#### s0040 **The Moderating Role of Cortisol**

p0140 Cortisol, like testosterone, is a steroid hormone. Cortisol is known primarily for its role in the physiological stress response

via activation of the hypothalamic-pituitary-adrenal axis (HPA-axis). The HPA-axis consists of the series of communications between the hypothalamus and the pituitary and adrenal glands. When the hypothalamus receives information that there is a threat in the environment, it relays a signal via the pituitary gland to the adrenal gland, which releases cortisol, as well as other hormones such as epinephrine and norepinephrine. The resulting stress response causes physiological changes which include increased respiration, heart rate, blood pressure, and blood glucose levels. These changes are all intended to prime the organism to physically respond to the threat by facilitating fight or flight behaviors. Unlike the catecholamines (i.e., epinephrine and norepinephrine), cortisol is able to pass through the blood-brain barrier, making it the primary behavioral influence during active stress responses. As such, cortisol has been shown to have not only physiological effects, but psychological and behavioral effects as well.

Not only is cortisol linked to the experience of stress, but it has been linked to approach and avoidance behaviors as well. Approach motivation is conceptualized as a broad system motivating behavior toward desirable and rewarding outcomes. Avoidance motivation, on the other hand, is a parallel system that motivates an individual to behave in ways that facilitate moving away from undesirable outcomes. Essentially, high approach motivation is characterized by appetitive behaviors and sensitivity to reward, whereas avoidance motivation is characterized by avoidant behaviors and sensitivity to punishment. High levels of cortisol have been found to correspond to behavioral inhibition, shyness, and introverted behavior, all avoidance motivation behaviors. Low levels of cortisol, on the other hand, have been found to correspond to extraverted and disinhibited behaviors, more approach-motivated behaviors.

Cortisol has been shown to play a moderating role between testosterone and behavior. Namely, high cortisol levels can suppress the action of testosterone. Given what we know about the relationship between testosterone and dominance behaviors, combined with the moderating role of status-relevant situational cues, the impact of cortisol provides yet another important factor underlying the manifestation of social competition. Testosterone is the underlying force driving social competition, but certain psychological (e.g., need for power) and situational (e.g., status threat) conditions must be met for testosterone to be manifested behaviorally. In addition to these conditions, testosterone's behavioral manifestation also depends on low levels of basal cortisol.

For instance, research shows that basal cortisol and basal testosterone interact to significantly predict individual differences in overt aggression among adolescent males, such that testosterone and aggression are related only when the individual also has low levels of cortisol. When cortisol is high, testosterone and aggression are unrelated. Furthermore, the effects of testosterone on competition and leadership behaviors are also only expressed when basal cortisol is low. For instance, when cortisol is low, basal testosterone predicts whether or not an individual will continue competing or will withdraw from competition after having been defeated once. Specifically, high basal testosterone motivates an individual to recompete after a loss, while low basal testosterone motivates withdrawal to avoid further losses, but this effect is only observed if basal cortisol is low. When cortisol is high the

effects of testosterone following a defeat are suppressed. This cortisol–testosterone interaction effect can even be extended to other dominance-relevant situations, such as leadership. Once again, basal cortisol moderates the effect of testosterone on behavior, such that when cortisol is low, the higher an individual’s basal testosterone, the more dominant their behavior will appear to others. This behavioral effect of testosterone completely disappears among those leaders who have high levels of basal cortisol.

p0160 This moderation suggests that the biological underpinnings of social competition are more complex than a univariate relationship between testosterone and competition. It is not enough to have a testosterone-fueled desire to attain and maintain high status, but one also needs to have an approach motivated social style to act on that desire. Or at the very least, to not have a socially fearful, avoidance motivated behavioral style.

p0165 Research on the physiological interaction of testosterone and cortisol suggests a number of possible mechanisms for how cortisol is able to moderate the relationship between testosterone and behavior. Just as cortisol is tied to the HPA-axis, testosterone is tied to the hypothalamic–pituitary–gonadal axis (HPG-axis). The HPG-axis cues the release of testosterone in preparation for reproductive behaviors. These two axes have an antagonistic relationship, that is, when one axis is activated, the other is suppressed. Thus, when the stress response is activated, reproductive behaviors will be suppressed until an organism’s physiology has returned to baseline. Cortisol, as well as other glucocorticoids, can also have an impact on the expression of androgen receptors. High levels of glucocorticoids downregulate the expression of androgen receptors. Thus, high levels of cortisol might not affect testosterone levels, but rather affect the degree to which testosterone could influence behavior by regulating the number of available receptor sites for testosterone to bind to.

## s0045 Sex Differences in Competition

p0170 As stated above, the majority of research on social competition has focused disproportionately on male behavior. There is a relative dearth of research on competitive behaviors among women, but the existing research does suggest that there are sex differences in how men and women engage with and react to competition. Some evolutionary psychologists have theorized that there should be clear sex differences in competitive behavior. Namely, men are more motivated by competition, both as individuals and as a group, whereas women are motivated by social needs. For instance, some behavioral research has found that women tend to cooperate more than men across situations, whereas men tend to cooperate with one another primarily as a means to compete as a group against another group. These theories suggest that, evolutionarily, women are more interested in protecting offspring and promoting social cohesion for the purposes of maintaining social stability and security. As is outlined below, there are mixed findings on how women’s competitive tendencies match or differ from those of men.

p0175 A number of research studies have found that females (both women and young girls) tend to be less competitive than their

male counterparts. There are a number of possible explanations for why men and women differ in their competitive tendencies. As mentioned above, some evolutionary theorists have suggested that although it is beneficial for men to engage in competitions to establish status, women benefit more from prosocial engagement to establish social stability. Research on stress and threat response behaviors seems to support this view, by exploring the possibility that the traditional ‘fight or flight’ response may be specific to male behavior, and that females may respond to threat by engaging with friendly conspecifics to establish safety and security in numbers. These theories suggest an inherent behavioral tendency away from competition and towards friendly social engagements among females.

On the other hand, anthropological research suggests that p0180 these sex differences in competitive behavior may result from strong socializing forces. When comparing patriarchal societies to matrilineal societies, women raised in a matrilineal society tend to be more behaviorally competitive than the men in that society, whereas in patriarchal societies, men tend to be the more competitive sex. These findings are conceptually in line with evolutionary theories in a broad sense, namely that different behavioral orientations (i.e., competitive versus cooperative) yield different social benefits. The clear difference between these views is whether these differences are innate or learned. It appears that it is some combination of both. Although research in anthropology has shown that socialization determines whether competitive behaviors are more prevalent among men or women, research in social endocrinology suggests that there are underlying physiological systems tied to sex differences in competitive behaviors.

As stated previously, women’s levels of circulating testosterone are much lower than men’s, due to differences in the sources of testosterone. The testes produce the vast majority of testosterone in men, whereas women’s testosterone is produced primarily by the adrenal glands, and to a lesser extent the ovaries. Ultimately, women have roughly a seventh of the amount of circulating testosterone as men. It is worth noting that although women’s testosterone levels are significantly lower than men’s, their basal testosterone is equally stable over time.

Research examining the relationship between testosterone and dominance in women has yielded mixed results in terms of whether testosterone’s effects are the same across sexes. Women’s basal testosterone predicts aggression and dominance, social status, performance in individual versus group competitions, and cognitive impairments associated with status mismatches. In fact, the research on the effects of status mismatches has been conducted primarily with mixed-sex samples, and has found similar patterns of results for both men and women. Some research, though, do not replicate the testosterone effects found in men among a female sample. Research on the anticipatory changes in testosterone prior to an athletic competition has found that some female athletes do not experience an elevation in testosterone leading up to a competition, but other findings support this relationship. Other research has also found that some female athletes do not experience the postcompetition fluctuations in testosterone (i.e., a win or lose dependent increase or decrease in testosterone), but other findings have found this postcompetition fluctuation. p0190

p0195 Although the replicability of testosterone–dominance findings among women is mixed, preliminary research has begun to examine the possibility of a female-specific endocrine-dependent form of dominance. Some researchers have found that certain hormones, for instance the estrogen estradiol, are better predictors of dominance behaviors in women than testosterone. This research suggests that women possess a similar endocrine–dominance relationship, simply one that is not necessarily testosterone specific. The research to date examining dominance in women indicates that further understanding of the potential sex differences in the physiological underpinnings of dominance behavior is an important and rich avenue for future research.

p0200 Although there appear to be sex differences in competitive behaviors, research is mixed as to what those differences are and what is underlying those differences. Behavioral research suggests that women are not as competitive as men, possibly due to socialization or due to the different evolutionary goals associated with competition versus cooperation. Social endocrinology research has also produced mixed results in terms of sex differences and dominance. Some research, such as reactions to status mismatches, show limited sex differences, yet other research, such as athletic competitions, show clear differences between men and women. These mixed results may be due to erroneously applying theories and approaches derived from male-specific research to females.

### s0050 **Competition and Behavioral Economics**

p0205 A rich field of research that has looked at human competitive behaviors is the field of behavioral economics. The study of behavioral economics relies on the basic premise that in most instances there are limited resources available to a group, thus creating an inherent conflict between the interests of the group and any one individual within that group. For instance, by focusing solely on one's own interests, the individual may utilize more of a given resource than his or her equitable portion. This overuse of a resource creates shortages for the rest of the group, which in turn leads to increased and potentially costly competition within the group. Behavioral economics utilizes interpersonal economic 'games' that rely on pitting an individual's self-interest against that of a cohort. In most instances, an individual can obtain a modest gain by cooperating with his/her partner, but could potentially obtain a larger gain by defecting from his/her partner. High levels of dispositional competitiveness have been linked to an increased propensity to betray one's partner to obtain more resources, but a number of situational and social factors influence behavior as well.

p0210 Research shows that the behavior of an individual's partner exerts a powerful influence over how that individual will behave. If a partner is viewed as acting unfairly, the other individual will respond by rejecting any kind of cooperation, even if that rejection knowingly causes all of the resources to be lost for both players. This retaliatory behavior serves to reinforce social cooperation and maintain a certain level of parity within the dyad regarding the distribution of resources. Aggressive and competitive behavior on the part of one's partner increases the likelihood that an individual will respond with

an equally aggressive and competitive behavioral style. The opposite effect has also been found to be true. Individuals are more likely to behave cooperatively and noncompetitively if they are interacting with a cooperative partner.

Two important situational factors moderate this reciprocal effect. First, reciprocity is particularly pronounced if individuals are interacting repeatedly over a series of trials. Repeated cooperative interactions lead to developing a sense of trust. Because individual success is tied to the behavior of the individual's partner, individuals recognize that punishing an aggressive partner and trusting a cooperative partner is the best strategy for maximizing one's gains. Second, physical distance and anonymity both decrease reciprocal behaviors. If an individual is physically isolated from his/her partner and is able to behave anonymously, it increases the likelihood that that individual will behave aggressively and competitively, regardless of the partners' behaviors. Anonymity appears to nullify the social motivation to reciprocate. p0215

The threat of retaliation is also affected by the magnitude of the resources at stake. When individuals are engaging with one another during an economic decision making game, the higher the stakes, the more likely individuals are to act fair and cooperate with one another. If there is relatively little to be gained or lost, individuals will act more competitively, because the potential to gain an extra amount is offset by the potential to lose an equally small amount. On the other hand, when the stakes are higher, not only is there a potentially larger gain to be had, but there is also the threat of potentially larger losses. Humans have a well established aversion to losses, so as the stakes increase, the threat of a large loss exerts a greater influence over behavior than the potential for a large gain, meaning that as the stakes increase, competitive behaviors decrease. p0220

In addition to situational and social forces, individual differences also influence whether one acts aggressively or cooperatively towards his/her partner. Research has shown that dispositional dominance is a power factor in determining whether an individual tends towards a competitive or cooperative orientation. The effect of dominance is moderated by situational forces, in some instances driving an individual to treat their partner as a competitor and attempt to secure as many resources for him/herself as possible, and actually facilitate cooperative behavior between individuals in other instances. p0225

In some interactions, an individual high in dispositional dominance may view cooperation as an acknowledgement that both individuals are equal, and may opt to act aggressively to establish his/her higher social status. Research has supported this theory, showing that high dominance individuals view these situations as moments of potential status instability. If the pair is even, at the outset, high dominance individuals will engage with their partner with a competitive motivation, attempting to acquire more resources than the partner in order to elevate their own status. If the pair is asymmetrical in some way (e.g., one individual has more resources than the other), high dominance individuals will respond to this asymmetry as a status challenge, and respond with aggression and/or retaliation in order to obtain or preserve their status. On the other hand, research has also shown that in certain circumstances high levels of dominance may actually increase the likelihood of cooperative behavior. Recall that there are a p0230

number of strategies for obtaining high status, one of which is to behave prosocially towards one's peers. In the context of economic games, by acting prosocially towards one's partner, it minimizes the likelihood that the partner will retaliate or punish the individual, and increases the likelihood that the partner will reciprocate the cooperative behavior. It has been suggested that a key circumstantial factor in determining which behavioral strategy will be adopted is whether or not an individual feels a continued dependence on one's partner to succeed. Individuals dependent on their partners are more likely to adopt a prosocial strategy, thus maximizing their benefit in the long term.

responses. These approaches are being combined with continued research on situational, environmental, and cultural influences over competitive behavior to further elucidate the dynamic and interactional relationship between the environment and biology that gives rise to complex social behaviors. Ultimately, the merging of multiple disciplines has led to a highly nuanced examination of the biological, social, and environmental forces influencing social competitive behaviors.

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### s0055 Conclusions and Current Research Trends

p0235 Competition among social animals takes many forms, including physical aggression between individuals over a specific resource and social competition for high status positions within a hierarchy. High status positions offer a much more efficient and less costly means to distribute limited resources. Just as is the case among rats, mice, chimpanzees, baboons, and countless other social animals, it is also the case among humans.

p0240 The primary biological fuel driving social competition is testosterone, which manifests itself behaviorally as dominance. Dominance behaviors are meant to facilitate one's ascension up the social hierarchy by besting other individuals within the same hierarchy. The effect that testosterone has on dominance behaviors is moderated by two important factors. One is the hormone cortisol, which acts as a behavioral inhibitor, such that when cortisol is high, testosterone's influence on behavior is suppressed. The other important factor is the presence/absence of appropriate social circumstances; namely, conditions under which competition will yield actual social rewards.

p0245 Recent research has begun to explore more complex neurobiological and genetic factors that may be influencing competitive behaviors. Neuroscience research is examining the potential role of brain structures related to emotion regulation and impulse control on behaviors such as aggression and economic decision making. Behavioral genetics research has been studying how genetic variations on neurotransmitter and neurochemical promoter genes potentially influence complex social behaviors, such as how the underexpression of certain neurotransmitters may reduce impulse control or blunt threat