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REVIEW ARTICLE

Dominance hierarchy in a nutshell: why, how, dangers and solutions

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Abstract

Life in societies has evolved as a response of organisms to environmental conditions. Dominance hierarchy forms an inner structure of a society which allows society members to stay together without repeated fighting. Access to resources is provided by hierarchical status. In the absence of resources, the lowest ranking individuals are the most at risk. Certain patterns of dominance hierarchy persist in modern people in Euro-American societies. Moreover, special patterns have occurred, such as parallel membership in various subgroups, voluntary access to some of the subgroups, reverse hierarchy, and tendencies towards equality. In spite of these changes, hierarchy still influences the life of an individual. The probability of survival, reproduction, communication and transfer of information may serve as examples. Both high hierarchical disparity and isolation cause stress and health problems. Feelings of guilt, fear, and stress can be used as markers of a harmful disparity. Warning signs include the lack of supportive interpersonal relationships, prestige, social norms, and cultural products that could mitigate the hierarchical difference.

In this review, we address the principles and functioning of dominance hierarchy, describe the structure of hierarchy in modern societies, and explain how the rank of the individual is determined and shapes the life of a person. We briefly summarize the basic patterns of dominant and submissive behaviour. The rank of the individual is predictable and so is the behaviour connected to his/her rank. This allows us to predict where particular aid and attention are required.

INTRODUCTION

One of the typical human adaptations is the formation of societies and coexistence within groups. Living in social groups follows certain rules (Redhead & Power 2022; Milewski *et al.* 2022; Strauss *et al.* 2022). We are able to observe social organization in ancient human populations as well as in indigenous communities who still preserve a lifestyle which has formed under natural conditions (Klindworth & Voland 1995; Gibson & Mace 2007; Reyes-Garcia *et al.* 2008; Morrison *et al.* 2018).

On the other hand humans tend towards equity (von Rueden *et al.* 2019). Boehm considered some tribal societies and both ancient and recent populations of gatherers and hunters to be egalitarian. But he admitted that egalitarianism does not have to apply to all members of these communities uniformly (fairly) (Boehm 2001; Boehm 1993). In fact, certain elements of behaviour related to the hierarchical organization of society also appear in contemporary Euro-American so-called westernized societies (e.g. (Pratto *et al.* 2006)).

Redhead and Power stressed that social hierarchies in humans 1) may not be based only on dominance, 2) there are multiple social hierarchies in society and, 3) overlapping social network do exist. The rank of an individual depending on his/her individual attributes represents the micro-level. The macro-level is defined by status hierarchies based on conventions and/or providing benefits to others. Interpersonal relationships create social network, i.e., mezzo-level. The dynamic and feedback between the grades contributes to the final arrangement (Redhead & Power 2022).

Both dominance and prestige can contribute to attaining the high status in social hierarchy in humans. While dominance means the aspect of the social hierarchy determined by aggression, threats or intimidation, prestige is derived from access to information, knowledge and skills. Dominance is characterized by feelings of fear or a need to avoid higher-ranking individuals. The ability to use the dominance strategy evolves from the early childhood (2-6 years). Prestige brings admiration and respect. The increasing importance of prestige strategy occurs in the middle childhood (Zeng *et al.* 2022).

The prestige, social norms, and cultural products (i.e. language) mitigate differences in dominance hierarchy. There is a leverage whereby subordinates can withhold cooperative benefits from higher-ranking individuals or even resort to ostracism of the higher-ranking to make the hierarchy more egalitarian (Zeng *et al.* 2022).

Despite these mechanisms, dominance "continues to contribute pervasively to status asymmetries in humans"(Zeng *et al.* 2022).

Dominant hierarchies represent an old and well-developed concept (Hobson, 2022; Strauss *et al.* 2022). This concept provides simple information that helps to read the behaviour. Although the structure of human society is complex (Strauss & Shizuka 2022), monitoring dominant hierarchies enables to quickly locate vulnerable individuals, and to understand their situation.

Here we explain the function and evolutionary background of dominance hierarchy in animals and characterize features of dominance hierarchy in humans in contemporary westernized societies. We also give examples of how dominance rank affects the life and behaviour of an individual, and draw attention to some of the risks caused by dominance hierarchy in families and society.

DEFINITION AND CONCEPTION OF DOMINANCE HIERARCHY IN ANIMAL BEHAVIOUR

The basic concept of dominance hierarchy was defined, explained, and elaborated in detail by classical behavioural sciences such as ethology and behavioural ecology (Alcock 2013; Manning & Dawkins 2009; McFarland 1981; Veselovský 2005; Hobson 2022). *Dominance hierarchy (social dominance hierarchy, social hierarchy)* is the way in which the society or the family is organized (Veselovský 2005; McFarland 1981; Manning & Dawkins 2009). Dominance hierarchy is a feature of a society or a family in which 1) the number of conflicts between individuals decreases because 2) some people give way to others and let them have resources without fighting (mostly based on their experiences from previous agonistic interactions), and 3) the higher-ranking individuals restrict the lower-ranking ones (Veselovský 2005; Manning & Dawkins 2009; Alcock 2013; McFarland 1981).

Several species adapt to environmental conditions by living in societies. The form of a society (number of members, ratio of males to females, and social structure, including dominance hierarchy) reflects the environmental conditions (Davies *et al.* 2012).

Dominance hierarchy enables its members to avoid repeated conflicts in society (Dwortz *et al.* 2022). Thus, individuals save their energy and decrease their chances of being injured by society members (Tibbetts *et al.* 2022). They remember which members they have lost to so they can therefore judge who is able to beat them. They retreat towards stronger members (Manning & Dawkins 2009). Usually more powerful members, such as bigger ones, stronger ones or those who display strength (Hamilton & Benincasa 2022; Dehnen *et al.* 2022), as well as those who have the support of community members, restrict others by means of threats. The lower-ranking individuals display a *submissive posture* to stop or slow down the aggression of the higher-ranking ones (McFarland 1981). Or, the lower-ranking individual uses *appeasement behaviour* to shift the aggressive behaviour of the higher-ranking one through sexual or parental behaviour (e.g., the lower-ranking one offers sex or behaves in a puppy-like manner) (Veselovský 2005).

In many socially living species, the lone individual has little or even no chance of surviving and reproducing outside of society. On account of this, lower-ranking individuals remain in societies despite having to yield resources (usually food, sexual partners, safe places, territories, etc.) to higher-ranking ones. The higher-ranking individuals have a higher number of offspring because of privileged access to resources and mating partners. Their offspring are stronger, more numerous, and survive better, owing to their preferential access to high quality partners, food and other resources. On the other hand, the lower-ranking individuals might not even reproduce at all. However, they can either help their relatives to reproduce, or simply wait for changes in their hierarchical status so that they could also transfer their genes to the next generations (McFarland 1981; Manning & Dawkins 2009; Veselovský 2005; Davies *et al.* 2012; Jozifkova 2014). Frequently, only the higher-ranking individuals reproduce; in this way a pack society is protected from overpopulation (Davies *et al.* 2012; Veselovský 2005).

The dominance hierarchical *rank* of an individual is determined by features which help to win the interaction (fight or ritualized fight). The important factors are body size, condition (health, pregnancy, age), gender, experiences, hierarchical rank of parents (some animals inherit their rank from their mother), family or clan, partnership (having a partner), rank of partner, ability to change the behaviour of other members (manipulation and cooperation), and personality, including aggression) and an inherited tendency to dominate or be subordinate (character dominance) (Borries *et al.* 1991; Veselovský 2005; Kim & Zuk 2000; Engh *et al.* 2000; Engh *et al.* 2009; Poisbleau *et al.* 2006; Lemmon *et al.* 1997; Colleter & Brown 2011; Feder *et al.* 2010; Lewis 2022; Strauss *et al.* 2022).

The rank of the individual living in society changes as the characteristics listed above change during his or her life. Once the individual reaches a high rank (one is rarely born with a specific hierarchical rank), one has to defend it, which can be costly.

The dominance hierarchical rank of the individual in society depends primarily on his ability to fight and/or to be supported by those who are able to fight. Less often, rank is maintained via positive interactions (grooming) (Manning & Dawkins 2009).

Dominance hierarchy may be *linear* with the most dominant animal (alpha), the second higher-ranking (beta), etc.(McFarland 1981). It may be *angular* or *circular* where the alpha rank is higher than the beta, and the beta dominates the gamma, but the alpha does not dominate the gamma (Franck 1996; Nakamichi & Koyama 1997; Manning & Dawkins 2009).The higher individuals often form a coalition to control the society accordingly, as has been observed in chimpanzees (Veselovský 2005; Franck 1996). Dominance hierarchy either includes all members of the society or there is a separate hierarchy for males and females (Veselovský 2005; Vervaecke *et al.* 2010). The hierarchy is divided if males and females compete for different resources. Moreover, all adult females may rank higher than males or, the adult males may rank higher than females in some species.

The higher-ranking individual often does not control everything all the time. A herd likes to follow the most experienced animal instead of the higher-ranking one (Ihl & Bowyer 2011; Jacobs *et al.* 2011). The leader could, for example, be the most experienced middle-ranking female.

The dominance hierarchical rank impacts the probability of an individual's survival and reproduction (Tibbetts *et al.* 2022; Milewski *et al.* 2022). The likelihood of getting food, space to rest or hide from predators, the chance to mate or the quality of a sexual partner – all these factors depend on hierarchical rank (Milewski *et al.* 2022). Also, the ways and options as to how the individual can behave in a society or family are influenced or even determined by his or her hierarchical rank. De Waal uses the term *"social cage"* when describing this everyday reality in chimpanzees (De Waal 1997).Nevertheless, dominance hierarchical rank has a significant impact on the life of an individual in human societies, too.

DOMINANCE HIERARCHY IN HUMANS

Human society is organized as a dominance hierarchy in which the members of some groups possess a higher social status and more power than members of other groups (Pratto *et al.* 2006). Dominance hierarchies may differ according to their adaptation to local ecological conditions. Again, dominance hierarchy is defined by both the mating systems (polygyny versus monogamy) and social systems (matriarchy versus patriarchy).

The current vociferous call for equality in modern society is expected to temper or displace some of the following patterns. But many patterns tend to persist. They are listed here as published in the past expert studies which were focused on features of modern Euro-American societies. Future research will show how far striving for improvement will be successful. There were certain features of modern Euro-American societies:

1) The males and the females are not separated in the dominance hierarchy. The male rank is slightly higher than that of a female with the same characteristics (Sidanius *et al.* 2006; Carli 2001; Fontaine & Vorauer 2019) , which is the subject of criticism. The adults have more power than children (Pratto *et al.* 2006).
2) There are also dominant hierarchies in smaller subgroups (family, residence, workplace, interest group, hobby group, hospital) (Rubin 2000). The individual enters some of these subgroups voluntarily. The ranks of the individual in different subgroups may be partially independent. These types of dominance hierarchy are unique. In the subgroups, the

individuals form coalitions. Similar dominance hierarchies arise even in cyberspace (Warren *et al.* 2012).

3) There are groups with a specific characteristic; these groups rank higher due to this characteristic: for example, rich persons rank higher, while those with mental illnesses rank lower (Pratto *et al.* 2006). Now many efforts are being made to make this feature visible and to improve the status of affected groups.
4) Societies which contain a large number of members within an *incomplete* hierarchy (such as citizens of a metropolis in a public transport system) are typical for humans. Moreover, larger groups formed of very similar individuals (a school class of same-age children) may show an incomplete hierarchy, too. These groups are likely to be forced or artificial; i.e. different from the formations which occurred at the time of human origin (Rubin 2000).
5) There is a varying degree of steepness in human hierarchy. The hierarchical disparity between the lower-ranking and the higher-ranking individual could be either severe or mild. Steepness exists not only within a group but also between groups of individuals. The terms *"steepness of the hierarchy"* and *"dominance gradient"* were used for this phenomenon in animals (Vervaecke *et al.* 2010; Jacobs *et al.* 2011). Ethologists discriminated between "tolerant" and "despotic" species. In humans, not only populations but also smaller groups (subpopulations) may differ in steepness.
6) Some individuals prefer a certain rank within a small group. They can prefer either a higher or lower rank by virtue of their inclination to dominate (dominance as a feature of personality) (Mast *et al.* 2010).
7) A reverse dominance hierarchy may show up temporarily. Boehm defined this term for a situation where lower-ranking members of a society band together to rule the higher-ranking ones through social pressure (Boehm 2001; Boehm 1993). Reverse dominance hierarchy was documented in hunters/gatherers and certain tribal societies (Boehm 2001). Contemporary examples of this behaviour include petitions, waves of criticism, acceptance/nonacceptance on social networks, and other means of expressing agreement or disagreement among multiple people. Individuals frequently gather to achieve their goals using these means.

HOW IS RANK IN HUMANS DETERMINED?

In humans, dominance hierarchical rank is determined by age, gender, health, physical condition, sexual attractiveness (in women), rank of one's parents, partner's rank, membership of a certain clan, ability to control resources and/or territory, as well as the behaviour of others (cooperation and/or manipulation), experiences, and the tendency to dominate or be subordinate as a feature of the individual's personality (Jozifkova 2014). Besides, other personality features may affect the status. A significant influence on the status has his or her prestige, as we mentioned in the introduction.

Men mostly ranked higher than women, while people suffering from mental health problems and sexual minorities ranked lower than others (Sidanius *et al.* 1994; Evans-Lacko *et al.* 2012; Ortiz-Hernandez 2005; Smith *et al.* 2017; Mason & Lewis 2019). At present, the impact of factors such as these is being suppressed by directly supporting disadvantaged subpopulations in modern societies. It was observed that women considered themselves less powerful than men when thinking about being in a lower-power position but they felt as powerful as men when they imagined having higher power. Such difference may be driven by an equalization effect (Fontaine & Vorauer 2019).

Features which are linked to higher social status increase the attractiveness of males (Evans *et al.* 2008). On the other hand, attractiveness increases the rank of women (Haas & Gregory 2005). However, this gender-dependent pattern may become weaker in future egalitarian societies (Fontaine & Vorauer 2019).

Hierarchical rank reflects physical attributes such as height, strength, facial features, voice, race, and attractiveness. The taller the person in good physical condition, the higher he or she is ranked (von Rueden *et al.* 2008; Buunk *et al.* 2021). Physically strong men are expected to have a higher rank in organizational status (Lukaszewski *et al.* 2016). Therefore, men with strong masculine facial features as well as those with a deeper voice are perceived as more dominant (Gangestad *et al.* 2004; Wolff & Puts 2010). It has been observed that African Americans with darker skin tones had lower socioeconomic status and lower prestige when compared to African American with lighter skin tones (Hochschild & Weaver 2007). Correction of phenomena similar to the latter is now in the spotlight (Puckett *et al.* 2020).

Also, a child's level of education is impacted by the socioeconomic status of their parents (Korupp *et al.* 2002). Unsurprisingly, men of a higher socioeconomic status are preferred by women as partners for long-term relationships (Gueguen & Lamy 2012). These women often improve their socioeconomic status by choosing such a man. Again, such preferences might be weakening in society when the differences between the status of men and women decrease.

The ability to gain access to and control scarce resources falls under the term "socioeconomic status". Socioeconomic status is commonly used to describe the rank within a human society and refers to the economic and social position of an individual or family in relations to others. It is usually based on income, education, employment or having a prestigious job, and property. Owning land may serve as both territory and resource (Voland *et al.* 1991). Frequently, cattle ownership is considered a resource (Guliye *et al.* 2007).

In Tsimane, men who have significant community support are also considered respected authorities (von

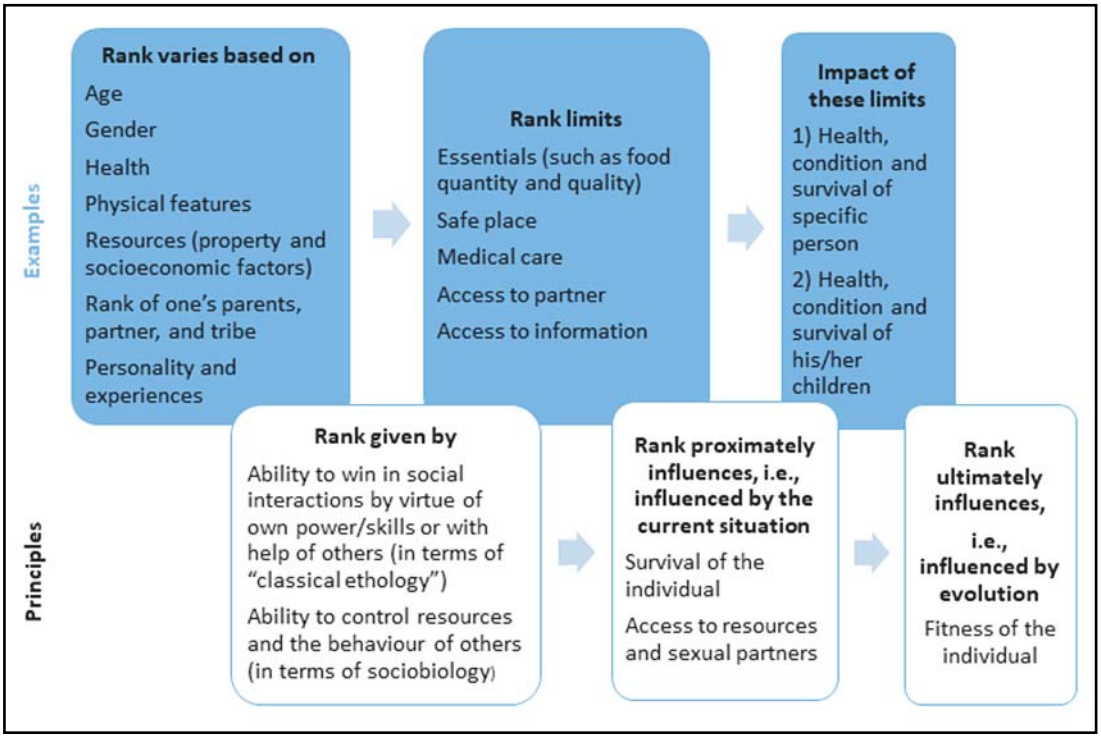

Fig. 1. Dominance hierarchy rank may influence the life of an individual: principles and examples

Rueden *et al.* 2008). Individuals who are prone to dominate (as a feature of their personality, the characteristic of dominance) are often considered authorities and can control a group because their behaviour makes them look competent, even if they lack the required abilities (Anderson & Kilduff 2009).

DOMINANCE HIERARCHICAL RANK CONTROLS THE LIFE OF AN INDIVIDUAL

There are several examples of the way in which hierarchical rank controls human life: higher-ranking Tsimane males in Amazonia showed markers of better nutrition; in Nepal, the youngest daughters-in-law deferred to other family members, cooked later and ate less than the rest of family; in India, higher-ranking people had better access to medical care; low-income and ethnic minority autistic youth had fewer chances of reaching postsecondary education, employment, and of participating in social activities; in Japan, elderly people (older than 64 years) were found to have a higher probability of surviving the next 1,064 days if they had higher socioeconomic status; black men had a shorter average life expectancy in the U.S.; persons of lower socioeconomic status were more likely to die as a result of hot weather in Hong Kong (Reyes-Garcia *et al.* 2008; Morrison *et al.* 2018; Maharani & Rahardjo 2012; Eilenberg *et al.* 2019; Hasegawa *et al.* 2011; Barrett *et al.* 2002; Bond & Herman 2016; Chan *et al.* 2012).

Both higher-ranking members of a church and men with a higher-ranking at university had more children (Mealey 1985; Fieder *et al.* 2005). Men who were in top positions in the Mormon Church had more wives (Mealey 1985). Male employees in leading positions at universities had more children than other male university employees (Fieder *et al.* 2005). In rural Ethiopia, the first wife ranked higher than the second and third wives. Children of first wives in plural marriages were likely to be heavier (in proportion to their height) than children of second and third wives (Gibson & Mace 2007).

REPRODUCTION

From the evolutionary-biological point of view, the rank of higher dominance is connected with gene quality, measured by means of facial symmetry (Roberts & Little 2008) and greater resistance to diseases, and access to resources (Thornhill & Gangestad 1993; Akkerhuis & Damgaard 1999). Thus, rank substantially impacts reproductive success (Deruiter & vanHooff 1993; von Rueden & Jaeggi 2016; Havlicek *et al.* 2005). A study based on phylogenetic multilevel meta-analysis of 33 nonindustrial societies has shown that the hierarchical status of men was connected with their reproductive success (von Rueden & Jaeggi 2016). Authors of the study have observed differences in marital systems. The social status of men has been found to be associated with lower mortality of offspring in polygynous societies and with higher "wife quality" (defined by authors as "wife's age or interbirth interval, wife's productivity") in monogamous societies (von Rueden & Jaeggi 2016).

Women are attracted to male features that demonstrate an increased rank, such as high social status, a dominant looking face, physical dominance, a masculine voice, and a dominant male odor (Fieder *et al.*

2005; Mealey 1985; Mueller & Mazur 1997; Wolff & Puts 2010; Feinberg *et al.* 2006; Havlicek *et al.* 2005). However, a proportion of woman prefer submissive males, while a proportion of men are sexually aroused by dominant personas (Jozifkova 2018). Individuals may increase their fitness even by preferring a lower rank, when the submissive one is paired with a dominant partner. Strikingly, such pairs have a higher reproductive success, regardless of the gender of the higher-ranking person in European urban populations (Jozifkova *et al.* 2014).

Higher status males have a higher frequency of copulation (Perusse 1993). They have more attractive women (e.g., more fertile because attractiveness is linked to fertility and/or genetic quality from the evolutionary biological point of view) (Buss & Shackelford 2008). When unable to compete with higher-ranking males, a lower-ranking male can use alternative reproduction tactics that range from socially acceptable activities to crimes such as rape (Davies *et al.* 2012; Diamond *et al.* 2011; Jozifkova *et al.* 2012; Jozifkova 2013; Thornhill & Palmer 2000).

COURTSHIP AND SEXUAL AROUSAL

The importance of hierarchical rank in reproduction explains why a specific behaviour indicating hierarchical rank is used during courtship in humans. Researchers observed markers of dominant behaviour in men during their courtship while women showed submission (Henley 1977; Moore 2010). These studies preceded societal changes during the last decades. In view of increasing gender equality, gender-specific distinctions in signals may be weakening in modern society (Fontaine & Vorauer 2019).

But even today, approximately half the population (or even more) has been found to be sexually excited by their partner's submission or their own submission (Jozifkova 2018; De Neef *et al.* 2019). A strong preference for hierarchical disparity has been found in 8.2% of them. Although the majority of men prefer submissive women and the majority of women prefer dominant men, a proportion of women (3.4%) is attracted to submissive males, while a proportion of men (6.1%) is sexually aroused by dominant females (Jozifkova 2018).

STRESS, VIOLENCE AND SUICIDE

After achieving a high hierarchical position, the individual is stressed by defending this position (Sapolsky 2005a). On the other hand, lower-ranking individuals are stressed by repeated attacks from higher-ranking ones (Sapolsky 2005a). Hormonal changes and even the health of the individual reflect hierarchical status within dominance hierarchy and changes in dominance hierarchy. It was observed that higher-ranking soldiers had higher cortisol levels than the lower-ranking ones when they believed that the lower-ranking colleague did not willingly relieve them when on guard (Siart *et al.* 2016).

In the experiment, experimenters manipulated the social rank of the participant and the degree of dominant behaviour of the participant's opponent. Participants with a low rank showed a greater increase in blood pressure. Participants who had to interact with a more dominant partner had higher systolic blood pressure, heart rate, and greater changes in cardiac activity. These findings supported the existence of a link between dominance hierarchy and cardiovascular diseases (Cundiff *et al.* 2016). Another study found that subjective social status was associated with health problems in workers in Sweden (Miyakawa *et al.* 2012).

In addition, there is another phenomenon to mention: the connection between a low position in a social hierarchy and increased stress in relation to the number of individuals in a group. The higher the number of high-ranking individuals, the more stressed the lower-ranking individuals (omegas) are. Lower relative income (compared to the median) was linked to higher mortality in people living in areas with populations of over 20,000 inhabitants in Norway, but no such connection was found in smaller cities (Elstad *et al.* 2006). The lower-ranking ones may suffer from stress-related health problems simply due to their lower rank. The phenomenon has been termed the "socioeconomic gradient" (Sapolsky 2005b).

In simple terms, lower-ranking individuals lose out in interactions with higher-ranking ones, resulting in hormonal changes, such as an increase in the level of cortisol. These changes have a negative impact on human health (Finn 2007). Moreover, cardiovascular disorders seem to be linked to hierarchical rank (Cundiff *et al.* 2016).

A decrease in hierarchical rank is linked to feelings of depression (Rohde 2001). Subordinate individuals and those who have lost their higher rank have a higher chance of becoming ill than higher-ranking individuals and those who win in social interaction (Gilbert & Allan 1998). A drop in hierarchical rank can even lead to suicidal tendencies, as has been observed in cases of sexual minorities or other excluded groups. The decrease in hierarchical rank of victims of domestic violence or bullying is evident (ncdsv.org ; Beck *et al.* 2011). An extreme decrease in rank limits the behaviour of victims, which is difficult to understand for those who lack this personal experience. Submissive behaviour in humans is related to their feelings of guilt, while angry people are perceived as more dominant (Hareli *et al.* 2009; O'Connor *et al.* 2000; Gilbert & Miles 2000).

Individuals who are excluded from society or who live alone are extremely stressed. This may lead to health problems and depressive symptoms (Finn 2007; Abe *et al.* 2012; Kelley-Moore *et al.* 2016; Forkmann *et al.* 2012; Holt-Lunstad *et al.* 2015; Calati

Tab. 1. Features of dominance hierarchy in modern Euro-American societies

1	Influence of gender and age
2	Several subgroups for one person, partially voluntarily entered
3	Modification by specific character of subgroup
4	Incomplete hierarchy in larger societies
5	Varying degree of hierarchical steepness
6	Individual differences in preferences to dominate (personality)
7	Reverse dominance hierarchy may appear

et al. 2019). Moreover, loneliness is connected with death and suicide (Holt-Lunstad *et al.* 2015; Calati *et al.* 2019). Therefore, self-isolation from a hostile society is not the solution.

On the other hand, some communities try to reduce the aforementioned risks by supporting endangered persons, preventing isolation and exclusion, and by moderating hierarchical disparity (Castillo *et al.* 2019; Trinh *et al.* 2019).

TRANSFER OF INFORMATION

A submissive individual (a person of a lower rank and/or somebody who is submissive as a feature of his/her personality) often agrees, does not oppose, does not insist on his or her opinion, does not express negative opinions, changes his/her opinion as well as his/her point of view, attitude and behaviour under pressure (Buss & Craik 1980; Goldberg 1999). A dominant individual (a higher-ranking one and/or somebody who has a dominant personality) often disagrees, contradicts, does not make concessions, stands up for his/her opinion, pressurizes others, does not change his/her opinion or point of view and attitude under pressure (Buss & Craik 1980; Goldberg 1999).

The dominant individual sets the course of communication: he/she more frequently starts and ends the conversation, dictates the length of the communication as well as the topics, and the volume of the communication (Henley 1977; Buss & Craik 1980; Goldberg 1999). This individual also asks questions, or even asks them repeatedly, interrupts others, and requires information. The submissive individual tends to give the dominant individual more information than is necessary. The dominant individual tends to hide information from others (Maner & Mead 2010).

Submissive individuals do not advance their own interests at all or at least not as much as dominant individuals, who often enforce their own interests, regardless of the interests of others (Buss & Craik 1980; Goldberg 1999; Maner & Mead 2010).

The quality of information crucially changes depending on the flow of information; whether it goes from the lower-ranking to the higher-ranking individual, or vice versa. For example, the lower-ranking one is likely to agree that he or she made a mistake, despite the fact that he or she did not (Buss & Craik 1980). In accordance with natural human behaviour, a third person considers any information from a dominant individual more valid and of higher importance than information from a submissive individual. This may worsen the situation for those who have their rank decreased (victims of violence, etc.).

COMMON FEATURES IN HUMAN BEHAVIOUR

Dominant individuals set rules, make decisions, and protect their interests regardless of others (Goldberg 1999; Freeman *et al.* 2009; Maner & Mead 2010). Submissive individuals often do not dare to protect themselves. It is typical for them to neglect their needs in favour of others, to comply with the requests of others; they are ready to please other people, avoid conflict or mitigate it, seek to appease aggression, and adapt to circumstances (Buss & Craik 1980; Henley 1977; Gilbert *et al.* 2003; Goldberg 1999).

Dominance hierarchy affects fairness. In an army experiment, the lower-ranking soldiers were found to remain on guard longer than their higher-ranking colleagues (Siart *et al.* 2016). The higher-ranking individuals were less empathetic (Sherman *et al.* 2015). Persons with high testosterone and low cortisol probably attain higher status in the social hierarchy, as has been observed in the "dove-hawk game" in which individuals with higher basal testosterone as well as those with an acute decrease in cortisol made more hawk-like decisions (Sherman *et al.* 2016; Mehta *et al.* 2017). Moreover, dominant men made decisions faster than low social-dominance men. Fast decision making was connected to higher activity in specific brain areas (da Cruz *et al.* 2018).

SUMMARY

Dominance hierarchy has evolved in order to decrease the number of conflicts between members of society (Veselovský 2005; Manning & Dawkins 2009; Alcock 2013; McFarland 1981). While establishing a hierarchical order, individuals gain experience as to whether they would win or lose with others. They act based on their previous experience and thus the number of conflicts decreases (Veselovský 2005; Manning & Dawkins 2009; Alcock 2013; McFarland 1981). Theoretically, the number of conflicts between members of society may increase in hierarchically unordered gatherings. Individuals who are of similar rank fight more vigorously which has been observed even in humans (Wright *et al.* 2019; Stulp *et al.* 2012).

In spite of the shift to equality, some elements of behaviour related to the hierarchical organization

of society are also evident in contemporary Euro-American so-called westernized societies (Table 1).

Humans naturally form dominance hierarchies; this feature complicates or may even block attempts of equality. It is important to monitor the steepness of the dominance hierarchy closely. The steep hierarchy may harm the lower-ranking ones, thus flattening the steepness by decreasing disparity could be beneficial. Feelings of guilt, fear, and stress can be used as markers of a harmful disparity. Warning sign is the lack of supportive interpersonal relationships, prestige, social norms, and cultural products that could mitigate the hierarchical difference.

Hierarchical order influences access to resources (Davies *et al.* 2012). The existence of hierarchically organized ranks may cause suffering among lower ranking individuals when resources are scarce (Jozífková & Koláčková 2020). Both resources and information are shared unequally in society. In humans, the hierarchical rank of an individual may limit his/her access to medical care, food, and a safe place to live (Reyes-Garcia *et al.* 2008; Morrison *et al.* 2018; Maharani & Rahardjo 2012; Eilenberg *et al.* 2019; Hasegawa *et al.* 2011; Barrett *et al.* 2002; Bond & Herman 2016; Chan *et al.* 2012). Moreover, lower status is a prediction of poorer health (Miyakawa *et al.* 2012).

Hierarchical rank plays a key role in the choice of partners. The higher-ranking can have more partners and higher quality partners which leads to increased fitness. This effect seems to be weaker in modern societies where the number of offspring per persona is low (Redhead & Power 2022). But regardless of this fact, the existence of the hierarchical rank, either the actual or the virtual, is so important that this phenomenon is connected to sexual arousal in a substantial portion of the recent human population.

Higher-ranking individuals protect a group that primarily includes their sexual partners and offspring. This is the way in which they increase their fitness and secure resources for their partners and offspring. Therefore, lower-ranking individuals may reach higher reproductive success when mating with higher-ranking ones.

Dominance hierarchy limits or even determines human behaviour regardless of whether or not we are aware of it (Figure 1). Rank predicts the main pressures that form his or her behaviour, including ways of solving interpersonal the problems and risks which the individual has to face. Depending on their hierarchical rank, individuals may respond completely differently to the same stimuli (Milewski *et al.* 2022).

They are likely to be deeply influenced by their rank in small local sub-groups (family, office, class) which is hidden from the observer. One should consider dominance hierarchy within a group as well as between groups of individuals, because it helps to predict several factors, such as the hierarchical status of a given person, the main pressures that form his or her behaviour, and also the access to information and health risks which the individual has to face.

Evolutionary causations may complicate establishment of equality in modern societies. Numerous features are still hierarchized despite the existence of a strong general support for ideas of fairness and equity. But there is an important step that can be realistically achieved: the diminution of the great hierarchical differences associated with negative phenomena.

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Dominance hierarchy enables individuals to stay together without repeated fighting. Access to resources is provided by individual rank. In modern human societies, certain patterns of hierarchy still persist while the new ones are evolving. Hierarchy influences individual lives in a predictable way which permits us to provide effective help.

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REFERENCES

1 Abe Y, Fujise N, Fukunaga R, Nakagawa Y, Ikeda M (2012). Comparisons of the prevalence of and risk factors for elderly depression between urban and rural populations in Japan. Int Psychogeriatr. **24**: 1235–1241.
2 Akkerhuis GaJM, Damgaard C (1999). Using resource dominance to explain and predict evolutionary success. Oikos. **87**: 609–614.
3 Alcock J (2013). Animal Behavior: An Evolutionary Approach. Sunderland: Sinauer Associates.
4 Anderson C, Kilduff GJ (2009). Why Do Dominant Personalities Attain Influence in Face-to-Face Groups? The Competence-Signaling Effects of Trait Dominance. J Pers Soc Psychol. **96**: 491–503.
5 Barrett L, Dunbar R, Lycett J (2002). Human Evolutionary Psychology. Princeton: Princeton University Press.
6 Beck JG, Mcniff J, Clapp JD, Olsen SA, Avery ML, Hagewood JH (2011). Exploring Negative Emotion in Women Experiencing Intimate Partner Violence: Shame, Guilt, and PTSD. Behav Ther. **42**: 740–750.
7 Boehm C (1993). Egalitarian Behavior and Reverse Dominance Hierarchy. Curr Anthropol. **34**: 227–254.
8 Boehm C (2001). Hierarchy in the Forest: The Evolution of Egalitarian Behavior. Harvard: Harvard University Press.
9 Bond MJ, Herman AA (2016). Lagging Life Expectancy for Black Men: A Public Health Imperative. Am J Public Health. **106**: 1167–1169.
10 Borries C, Sommer V, Srivastava A (1991). Dominance, Age, and Reproductive Success in Free-Ranging Female Hanuman Langurs (Presbytis-Entellus). Int J Primatol. **12**: 231–257.
11 Buss DM, Craik KH (1980). The Frequency Concept of Disposition - Dominance and Prototypically Dominant Acts. J Pers. **48**: 379–392.
12 Buss DM, Shackelford TK (2008). Attractive Women Want it All: Good Genes, Economic Investment, Parenting Proclivities, and Emotional Commitment. Evol Psychol. **6**: 134–146.
13 Buunk AP, Stulp G, Schaufeli WB (2021). Effect of Self-reported Height on Occupational Rank Among Police Officers: Especially for Women it Pays to be Tall. Evol Psychol Sci. **7**: 411–418.
14 Calati R, Ferrari C, Brittner M, Oasi O, Olie E, Carvalho AF (2019). Suicidal thoughts and behaviors and social isolation: A narrative review of the literature. J Affect Disord. **245**: 653–667.

15 Carli LL (2001). Gender and social influence. J Soc Issues. **57**: 725–741.
16 Castillo EG, Ijadi-Maghsoodi R, Shadravan S, Moore E, Mensah MO, Docherty M, et al. (2019). Community Interventions to Promote Mental Health and Social Equity. Curr Psychiatry Rep. **21**.
17 Colleter M, Brown C (2011). Personality traits predict hierarchy rank in male rainbowfish social groups. Anim Behav. **81**: 1231–1237.
18 Cundiff JM, Smith TW, Baron CE, Uchino BN (2016). Hierarchy and Health: Physiological Effects of Interpersonal Experiences Associated With Socioeconomic Position. Health Psychol. **35**: 356–365.
19 Da Cruz J, Rodrigues J, Thoresen JC, Chicherov V, Figueiredo P, Herzog MH, et al. (2018). Dominant men are faster in decision-making situations and exhibit a distinct neural signal for promptness. Cereb Cortex. **28**: 3740–3751.
20 Davies NB, Krebs JR, West SA (2012). An Intorduction to Behavioural Ecology. Oxford: Wiley-Blackwell.
21 De Neef N, Coppens V, Huys W, Morrens M (2019). Bondage-Discipline, Dominance-Submission and Sadomasochism (BDSM) From an Integrative Biopsychosocial Perspective: A Systematic Review. Sex Med. **7**: 129–144.
22 De Waal FBM (1997). Good Natured. United States: Harward University Press.
23 Dehnen T, Papageorgiou D, Nyaguthii B, Cherono W, Penndorf J, Boogert NJ, et al. (2022). Costs dictate strategic investment in dominance interactions. Philos Trans R Soc Lond B Biol. Sc **377**.
24 Deruiter JR, Vanhooff J (1993). Male-Dominance Rank and Reproductive Success in Primate Groups. Primates. **34**: 513–523.
25 Diamond M, Jozifkova E, Weiss P (2011). Pornography and Sex Crimes in the Czech Republic. Arch Sex Behav. **40**: 1037–1043.
26 Dwortz MF, Curley JP, Tye KM, Padilla-Coreano N (2022). Neural systems that facilitate the representation of social rank. Philos Trans R Soc Lond B Biol Sc. **377**.
27 Eilenberg JS, Paff M, Harrison AJ, Long KA (2019). Disparities Based on Race, Ethnicity, and Socioeconomic Status Over the Transition to Adulthood Among Adolescents and Young Adults on the Autism Spectrum: a Systematic Review. Curr Psychiatry Rep. **21**.
28 Elstad JI, Dahl E, Hofoss D (2006). Associations between relative income and mortality in Norway: a register-based study. Eur J Public Health. **16**: 640–644.
29 Engh AL, Esch K, Smale L, Holekamp KE (2000). Mechanisms of maternal rank 'inheritance' in the spotted hyaena, Crocuta crocuta. Anim Behav. **60**: 323–332.
30 Engh AL, Hoffmeier RR, Seyfarth RM, Cheney DL (2009). O brother, where art thou? The varying influence of older siblings in rank acquisition by female baboons. Behav Ecol Sociobiol. **64**: 97–104.
31 Evans-Lacko S, London J, Japhet S, Rusch N, Flach C, Corker E, et al. (2012). Mass social contact interventions and their effect on mental health related stigma and intended discrimination. BMC Public Health. **12**.
32 Evans S, Neave N, Wakelin D, Hamilton C (2008). The relationship between testosterone and vocal frequencies in human males. Physiol Behav. **93**: 783–788.
33 Feder Y, Nesher E, Ogran A, Kreinin A, Malatynska E, Yadid G, et al. (2010). Selective breeding for dominant and submissive behavior in Sabra mice. J Affect Disord. **126**: 214–222.
34 Feinberg DR, Jones BC, Law-Smith MJ, Moore FR, Debruine LM, Cornwell RE, et al. (2006). Menstrual cycle, trait estrogen level, and masculinity preferences in the human voice. Horm Behav. **49**: 215–222.
35 Fieder M, Huber S, Bookstein FL, Iber K, Schafer K, Winckler G, et al. (2005). Status and reproduction in humans: New evidence for the validity of evolutionary explanations on basis of a university sample. Ethology. **111**: 940–950.
36 Finn MV (2007). Evolution of stress response to social threat. The Oxford Handbook of Evolutionary Psychology. Dunbar R and Barrett L. New York, Oxford University Press: 273–295.
37 Fontaine ASM, Vorauer JD (2019). How Low Can You(r Power) Go? It Depends on Whether You are Male or Female. Sex Roles. **80**: 147–158.
38 Forkmann T, Brahler E, Gauggel S, Glaesmer H (2012). Prevalence of Suicidal Ideation and Related Risk Factors in the German General Population. J Nerv Ment Dis. **200**: 401–405.
39 Franck D (1996). Etologie. Prague: Karolinum.
40 Freeman JB, Rule NO, Adams RB, Ambady N (2009). Culture shapes a mesolimbic response to signals of dominance and subordination that associates with behavior. Neuroimage. **47**: 353–359.
41 Gangestad SW, Simpson JA, Cousins AJ, Garver-Apgar CE, Christensen PN (2004). Women's preferences for male behavioral displays change across the menstrual cycle. Psychol Sci. **15**: 203–207.
42 Gibson MA, Mace R (2007). Polygyny, reproductive success and child health in rural Ethiopia: Why marry a married man? J Biosoc Sci. **39**: 287–300.
43 Gilbert P, Allan S (1998). The role of defeat and entrapment (arrested flight) in depression: an exploration of an evolutionary view. Psychol Med. **28**: 585–598.
44 Gilbert P, Cheung M, Grandfield T, Campey F, Irons C (2003). Recall of threat and submissiveness in childhood: Development of a new scale and its relationship with depression, social comparison and shame. Clin Psychol & Psychother. **10**: 108–115.
45 Gilbert P, Miles JNV (2000). Sensitivity to Social Put-Down: it's relationship to perceptions of social rank, shame, social anxiety, depression, anger and self-other blame. Pers Individ Dif. **29**: 757–774.
46 Goldberg LR (1999). A broad-bandwidth, public domain, personality inventory measuring the lower-level facets of several five-factor models. Personality Psychology in Europe. Mervielde I, Deary I, De Fruyt F and Ostendorf F. Tilburg, Tilburg University Press: 7–28.
47 Gueguen N, Lamy L (2012). Men's Social Status and Attractiveness Women's Receptivity to Men's Date Requests. Swiss J Psychol. **71**: 157–160.
48 Guliye AY, Noor IM, Bebe BO, Kosgey IS (2007). Role of camels (Camelus dromedarius) in the traditional lifestyle of Somali pastoralists in northern Kenya. Outlook Agric. **36**: 29–34.
49 Haas A, Gregory SW (2005). The impact of physical attractiveness on women's social status and interactional power. Sociol Forum. **20**: 449–471.
50 Hamilton IM, Benincasa MD (2022). Emergence of size-structured dominance hierarchies through size-dependent feedback. Philos Trans R Soc Lond B Biol Sc. **377**.
51 Hareli S, Shomrat N, Hess U (2009). Emotional Versus Neutral Expressions and Perceptions of Social Dominance and Submissiveness. Emotion. **9**: 378–384.
52 Hasegawa T, Hoshi T, Nakayama N, Bosako Y, Takahashi T, Sakurai N, et al. (2011). The Effects of Socioeconomic Status and Lifestyle on Life Expectancy: A Structural Analysis of an Elderly Japanese Population. Int Medical J. **18**: 261–264.
53 Havlicek J, Roberts SC, Flegr J (2005). Women's Preference for Dominant Male Odour: Effects of Menstrual Cycle and Relationship Status. Biol Lett. **1**: 256–259.
54 Henley NM (1977). Body politics: Power, sex and nonverbal communication. Englewood Cliffs, New Jersey (USA): Prentice-Hall.
55 Hobson EA (2022). Quantifying the dynamics of nearly 100 years of dominance hierarchy research. Philos Trans R Soc Lond B Biol Sc. **377**.
56 Hochschild JL, Weaver V (2007). The skin color paradox and the American racial order. Soc Forces. **86**: 643–670.
57 Holt-Lunstad J, Smith TB, Baker M, Harris T, Stephenson D (2015). Loneliness and social isolation as risk factors for mortality: a meta-analytic review. Perspect Psychol Sci. **10**: 227–237.
58 Chan EYY, Goggins WB, Kim JJ, Griffiths SM (2012). A study of intracity variation of temperature-related mortality and socioeconomic status among the Chinese population in Hong Kong. J Epidemiol Community Health. **66**: 322–327.
59 Ihl C, Bowyer RT (2011). Leadership in mixed-sex groups of muskoxen during the snow-free season. J Mammal. **92**: 819–827.
60 Jacobs A, Watanabe K, Petit O (2011). Social Structure Affects Initiations of Group Movements but Not Recruitment Success in Japanese Macaques (Macaca fuscata). Int J Primatol. **32**: 1311–1324.
61 Jozifkova E (2013). Consensual Sadomasochistic Sex (BDSM): The Roots, the Risks, and the Distinctions Between BDSM and Violence. Curr Psychiatry Rep. **15**: 392–392.
62 Jozifkova E (2014). Úvod do etologie sociální hierarchie: základní principy dominance a submisivity v biologii chování. Habilitation thesis, Masaryk Univerzity, Brno.
63 Jozifkova E (2018). Sexual Arousal by Dominance and Submissiveness in the General Population: How Many, How Strongly, and Why? Dev Behav. **39**: 1229–1236.

64 Jozifkova E, Bartos L, Flegr J (2012). Evolutional background of dominance/submissivity in sex and bondage: the two strategies? Neuroendocrinol Lett. **33**: 636–642.
65 Jozífkova E, Kolackova M (2020). Dominanční hierarchie. Anthropologia Integra. **11**: 7–16.
66 Jozifkova E, Konvicka M, Flegr J (2014). Why do some women prefer submissive men? Hierarchically disparate couples reach higher reproductive success in European urban humans. Neuroendocrinol Lett. **35**: 594–601.
67 Kelley-Moore JA, Cagney KA, Skarupski KA, Everson-Rose SA, De Leon CFM (2016). Do Local Social Hierarchies Matter for Mental Health? A Study of Neighborhood Social Status and Depressive Symptoms in Older Adults. J Gerontol B Psychol Sci Soc Sci. **71**: 369–377.
68 Kim T, Zuk M (2000). The effects of age and previous experience on social rank in female red junglefowl, Gallus gallus spadiceus. Anim Behav. **60**: 239–244.
69 Klindworth H, Voland E (1995). How Did the Krummhorn Elite Males Achieve Above-Average Reproductive Success. Hum Nat. **6**: 221–240.
70 Korupp SE, Ganzeboom HBG, Van Der Lippe T (2002). Do mothers matter? A comparison of models of the influence of mothers' and fathers' educational and occupational status on children's educational attainment. Qual Quant. **36**: 17–42.
71 Lemmon D, Withiam ML, Barkan CPL (1997). Mate protection and winter pair-bonds in black-capped chickadees. Condor. **99**: 424–433.
72 Lewis RJ (2022). Aggression, rank and power: why hens (and other animals) do not always peck according to their strength. Philos Trans R Soc Lond B Biol Sc. **377**.
73 Lukaszewski AW, Simmons ZL, Anderson C, Roney JR (2016). The Role of Physical Formidability in Human Social Status Allocation. J Pers Soc Psychol. **110**: 385–406.
74 Maharani DA, Rahardjo A (2012). Is the utilisation of dental care based on need or socioeconomic status? A study of dental care in Indonesia from 1999 to 2009. Int Dent J. **62**: 90–94.
75 Maner JK, Mead NL (2010). The Essential Tension Between Leadership and Power: When Leaders Sacrifice Group Goals for the Sake of Self-Interest. J Pers Soc Psychol. **99**: 482–497.
76 Manning A, Dawkins MS (2009). An Introduction To Animal Behavior. New York: Cambridge University Press.
77 Mason TB, Lewis RJ (2019). Clustered Patterns of Behavioral and Health-Related Variables Among Young Lesbian Women. Behav Ther. **50**: 683–695.
78 Mast MS, Hall JA, Schmid PC (2010). Wanting to Be Boss and Wanting to Be Subordinate: Effects on Performance Motivation. J Appl Soc Psychol. **40**: 458–472.
79 Mcfarland D (1981). The Oxford Companion to Animal Behavior. Oxford: Oxford University Press.
80 Mealey L (1985). The relationship between social status and biological success: A case study of the Mormon religious hierarchy. Ethol Sociobiol. **6**: 249–257.
81 Mehta PH, Desjardins NML, Van Vugt M, Josephs RA (2017). Hormonal underpinnings of status conflict: Testosterone and cortisol are related to decisions and satisfaction in the hawk-dove game. Horm Behav. **92**: 141–154.
82 Milewski TM, Lee W, Champagne FA, Curley JP (2022). Behavioural and physiological plasticity in social hierarchies. Philos Trans R Soc Lond B Biol Sc. **377**.
83 Miyakawa M, Hanson LLM, Theorell T, Westerlund H (2012). Subjective social status: its determinants and association with health in the Swedish working population (the SLOSH study). Eur J Public Health. **22**: 593–597.
84 Moore MM (2010). Human Nonverbal Courtship Behavior-A Brief Historical Review. J Sex Res. **47**: 171–180.
85 Morrison J, Dulal S, Harris-Fry H, Basnet M, Sharma N, Shrestha B et al. (2018). Formative qualitative research to develop community-based interventions addressing low birth weight in the plains of Nepal. Public Health Nutr. **21**: 377–384.
86 Mueller UO, Mazur A (1997). Facial dominance in Homo sapiens as honest signaling of male quality. Behav Ecol. **8**: 569–579.
87 Nakamichi M, Koyama N (1997). Social relationships among ringtailed lemurs (Lemur catta) in two free-ranging troops at Berenty Reserve, Madagascar. Int J Primatol. **18**: 73–93.
88 Ncdsv.Org. Power and Control wheel NO SHADING - NCDSV.indd. Retrieved 11. 11. 2021, from http://www.ncdsv.org/images/powercontrolwheelnoshading.pdf.
89 O'connor LE, Berry JW, Weiss J, Schweitzer D, Sevier M (2000). Survivor guilt, submissive behaviour and evolutionary theory: The down-side of winning in social comparison. Br J Med Psychol. **73**: 519–530.
90 Ortiz-Hernandez L (2005). Influence of internalized oppression on the mental health of homosexuals, lesbians and bisexuals in Mexico City. Salud Mental. **28**: 49–65.
91 Perusse D (1993). Cultural and Reproductive Success in Industrial-Societies - Testing the Relationship at the Proximate and Ultimate Levels. Behav Brain Sci. **16**: 267–283.
92 Poisbleau M, Fritz H, Valeix M, Perroi PY, Dalloyau S, Lambrechts MM (2006). Social dominance correlates and family status in wintering dark-bellied brent geese, Branta bernicla bernicla. Anim Behav. **71**: 1351–1358.
93 Pratto F, Sidanius J, Levin S (2006). Social dominance theory and the dynamic of intergroup relations: Taking stock and looking forward. Eur Rev Soc Psychol. **17**: 271–320.
94 Puckett JA, Dubois LZ, Mcneill JN, Hanson C (2020). The Association between Social Dominance Orientation, Critical Consciousness, and Gender Minority Stigma. J Homosex. **67**: 1081–1096.
95 Redhead D, Power EA (2022). Social hierarchies and social networks in humans. Philos Trans R Soc Lond B Biol Sc. **377**.
96 Reyes-Garcia V, Mcdade TW, Molina JL, Leonard WR, Tanner SN, Huanca T (2008). Social rank and adult male nutritional status: Evidence of the social gradient in health from a foraging-farming society. Soc Sci Med. **67**: 2107–2115.
97 Roberts SC, Little AC (2008). Good genes, complementary genes and human mate preferences. Genetica **132**: 309–321.
98 Rohde P (2001). The relevance of hierarchies, territories, defeat for depression in humans: hypotheses and clinical predictions. J Affect Disord. **65**: 221–230.
99 Rubin PH (2000). Hierarchy. Hum Nat. **11**: 259–279.
100 Sapolsky RM (2005a). The influence of social hierarchy on primate health. Science. **308**: 648–652.
101 Sapolsky RM (2005b). Sick of Poverty. Sci Am. **293**: 92–99.
102 Sherman GD, Lerner JS, Josephs RA, Renshon J, Gross JJ (2016). The Interaction of Testosterone and Cortisol Is Associated With Attained Status in Male Executives. J Pers Soc Psychol. **110**: 921–929.
103 Sherman GD, Lerner JS, Renshon J, Ma-Kellams C, Joel S (2015). Perceiving Others' Feelings: The Importance of Personality and Social Structure. Soc Psychol Personal Sci. **6**: 559–569.
104 Siart B, Pfluger L, Wallner B (2016). Pulling Rank: Military Rank Affects Hormone Levels and Fairness in an Allocation Experiment. Front Psychol. **7**.
105 Sidanius J, Pratto F, Bobo L (1994). Social-Dominance Orientation and the Political Psychology of Gender - A Case of Invariance. J Pers Soc Psychol. **67**: 998–1011.
106 Sidanius J, Sinclair S, Pratto F (2006). Social dominance orientation, gender, and increasing educational exposure. J Appl Soc Psychol. **36**: 1640–1653.
107 Smith NG, Hart TA, Kidwai A, Vernon JRG, Blais M, Adam B (2017). Results of a Pilot Study to Ameliorate Psychological and Behavioral Outcomes of Minority Stress Among Young Gay and Bisexual Men. Behav Ther. **48**: 664–677.
108 Strauss ED, Curley JP, Shizuka D, Hobson EA (2022). The centennial of the pecking order: current state and future prospects for the study of dominance hierarchies. Philos Trans R Soc Lond B Biol Sc. **377**.
109 Strauss ED, Shizuka D (2022). The dynamics of dominance: open questions, challenges and solutions. Philos Trans R Soc Lond B Biol Sc. **377**.
110 Stulp G, Kordsmeyer T, Buunk AP, Verhulst S (2012). Increased aggression during human group contests when competitive ability is more similar. Biol Lett. **8**: 921–923.
111 Thornhill R, Gangestad SW (1993). Human Facial Beauty - Averageness, Symmetry, and Parasite Resistance. Hum Nat. **4**: 237–269.
112 Thornhill R, Palmer CT (2000). A natural history of rape. Cambridge, England: The MIT Press.

113 Tibbetts EA, Pardo-Sanchez J, Weise C (2022). The establishment and maintenance of dominance hierarchies. Philos Trans R Soc Lond B Biol Sc. **377**.
114 Trinh N-HT, Bernard-Negron R, Ahmed II (2019). Mental Health Issues in Racial and Ethnic Minority Elderly. Curr Psychiatry Rep. **21**: 102.
115 Vervaecke H, De Bonte L, Maertens L, Tuyttens F, Stevens JMG, Lips D (2010). Development of Hierarchy and Rank Effects in Weaned Growing Rabbits (Oryctolagus Cuniculus). World Rabbit Sci. **18**: 139–149.
116 Veselovský Z (2005). Etologie. Prague: Academia.
117 Voland E, Siegelkow E, Engel C (1991). Cost/benefit oriented parental investment by high status families: The Krummhorn case. Ethol Sociobiol. **12**: 105–118.
118 Von Rueden C, Gurven M, Kaplan H (2008). The multiple dimensions of male social status in an Amazonian society. Evol Hum Behav. **29**: 402–415.
119 Von Rueden CR, Jaeggi AV (2016). Men's status and reproductive success in 33 nonindustrial societies: Effects of subsistence, marriage system, and reproductive strategy. Proc Natl Acad Sci U S A. **113**: 10824–10829.
120 Von Rueden CR, Redhead D, O'gorman R, Kaplan H, Gurven M (2019). The dynamics of men's cooperation and social status in a small-scale society. Proc Royal Soc B. **286**.
121 Warren J, Stoerger S, Kelley K (2012). Longitudinal gender and age bias in a prominent amateur new media community. New Media Soc. **14**: 7–27.
122 Wolff SE, Puts DA (2010). Vocal masculinity is a robust dominance signal in men. Behav Ecol Sociobiol. **64**: 1673–1683.
123 Wright E, Galbany J, Mcfarlin SC, Ndayishimiye E, Stoinski TS, Robbins MM (2019). Male body size, dominance rank and strategic use of aggression in a group-living mammal. Anim Behav. **151**: 87–102.
124 Zeng TC, Cheng JT, Henrich J (2022). Dominance in humans. Philos Trans R Soc Lond B Biol Sci. **377**.