

Evolution of behaviour in animals and humans



INTRODUCTION

Darwin and natural selection

Darwin explained the evolution of morphological and behavioral differences by putting forward certain basic processes. According to Darwin Individuals do not vary only from the members of distinct species but from con-specific too. These variations are the result of the effect of conditions of life on the reproductive systems of individual. In order to survive under the physical conditions of life individuals have to struggle not only with the physical conditions but with the individuals of con-specific and distinct species - Struggle For Existence - It does include the struggle for leaving progeny where male do struggle for possession of female and female choice. Hence, any variation, even slight, in anyway if improves the position of an individual either for survival or for mate over members of the con-specific or distinct species under the present environmental conditions will be preserved through the processes of natural selection and harmful will be eliminated. Neutral variations will be latent and will not be affected because natural selection works directly on the characters which are manifested and anyway affecting the individual (Darwin, 1859).

However, accounting for many behaviors and morphological differences he failed to explain altruism in terms of natural selection. Altruism can be defined as an act that benefits the individual for whom it has been performed but costs the organism performing it in terms of reproductive success (Trivers, 1974). In 1963, Hamilton added new perspective to the evolution of behavior and explained it by considering the effect of that

behavior on the inclusive fitness of the individual organism. Inclusive fitness refers to one's own reproductive success and reproductive success of kin multiplied by the degree of relatedness. For an altruistic act to be performed to have survival value for a relative its benefit/cost ratio has to be larger than the inverse of the altruist's degree of relatedness to that relative. These costs and benefits have been defined in terms of reproductive success (Hamilton, 1963). Hamilton has explained altruism in relation to the degree of genes shared. Taking one more step ahead, Trivers explains altruism in individuals which are not closely related even at the level of different species. He sees altruistic act in terms of reciprocity. According to him it's the exchange that supports such altruism. Altruistic acts are performed on the unequal cost/benefit ratio of the altruistic act, that is when the cost (degree to which the behavior retards the reproduction of the genes of the altruist) to performer is trivial as compared to the benefit (degree to which the behavior increases the rate of reproduction of the genes of the recipient) of the recipient and recipient may not be closely related. However, performer expects reciprocity in future when situation might be reverse. Selection will act against the cheater (one who does not reciprocate) under certain conditions. Trivers has given three conditions following it. 1) Length of lifetime should be long enough to increases the probability of encountering many altruistic acts. 2) Dispersal rate should be low which again increases the probability of repeated interaction with the same neighbors. 3) Interdependence of members of a species, which will also increase the probability of encountering many altruistic situations together. Selection favors these altruistic behaviors because in the long run they benefit the organism performing these acts (Trivers, 1971). Taking base of evolution of <https://assignbuster.com/evolution-of-behaviour-in-animals-and-humans/>

behavior in given frame of evolutionary origin; social behavior can be explained in terms of an evolutionary advantage of such behavior.

Life-history traits

The life history of an organism is often described by the features of its life cycle pertaining to its developmental and reproductive rates as well as reproductive effort (Roff 1992; Stearns 1992). In mammals, gestation length, size, number, and sex of offspring, inter-birth interval, age and size at first breeding, and life span are the significant life history traits (Charnov 1991).

Primate's life history is the slowest among the mammals (Harvey & Clutton-brock 1985, Harvey, Martin & Clutton-brock 1987, Ross 1988, Charnov & Berrigan 1993, Lee 1996, Ross 1998). It has turned out to be obvious that the individual traits that contribute to the life history patterns typical of any mammalian species are in a way coordinated within an adaptive framework.

Primate's birth, growth and death rates in particular are lower than individuals of other mammals after controlling for differences in body size.

Individual components most prominent like gestation period, size and number of offspring, lactation period, size and age of weaning, inter-birth interval (Martin & Mac Iarnon 1988, Charnov 1991, Harvey & Nee 1991, Lee, Majly & Gordon 1991, Ross 1992a, Charnov & Berrigan 1993) decide the rate of population growth. Within a species, these components show distinctive values with varying levels of flexibility and mutually yield the characteristic life history patterns.

In animals, the ultimate goal is to maximize reproductive success. In primates, this is generally achieved in females by having few young, and

<https://assignbuster.com/evolution-of-behaviour-in-animals-and-humans/>

investing a great deal of time and effort into rearing them (lactating etc.).

This large investment in a few offspring is often described as K-selected (MacArthur, 1962). Male primates, in general, take very little interest in helping to rear offspring. Their approach to maximizing their reproductive success is to father as many offspring as possible and not to invest much in individual ones. This is often described as r-selection (MacArthur & Wilson, 1967).

Primate life histories and socio ecology

- *Pre Natal and Post Natal Development*

In primates gestation and lactation vary in duration between two and nine months and between two months and several years (Harvey, Martin and Clutton-Brock, 1987; Lee, 1996). And with considerable variability within and among taxa weaning appears to occur around the time when the infants have reached about one third of their adult body mass (Lee et al. 1991; Lee, 1996). The prenatal and postnatal maternal investments have important consequence for behaviour, especially for male reproductive strategies. The ratio of lactation time to gestation time is a strong predictor of vulnerability to infanticide by males especially in primates (Van Schaik and Kappeler, 1997; Van Schaik, 2000). Males who have not produced current offspring but are in a good position to mate with females benefits from killing infants because weaning of primates occurs relatively late (Lee et al., 1991). This risk of infanticide has been suggested to have chosen for female gregariousness (Brereton, 1995), male female friendships (Palombi et al., 1997), year around male female association (Paul et al., 2000), Female transfer and choice of target group (Steenbeck, 2000; Sterck and Korstjens,

2000; Watts, 2000), social and other aspects of female reproductive biology (Van Noordwijk and Van Schaik, 2000; Van Schak et al., 2000).

According to the sexual selection hypothesis, infanticidal males will gain reproductive advantage provided that only the unrelated infants are killed and that the males increase their chances of siring the next infants. (Borries et al., 2011; Zhao et al., 2011). On the other hand the social pathology hypothesis interprets infanticide as an effect of crowded living conditions and, not providing any advantage (Hrdy, 1979).

Infanticide risk might result from interaction between number of females and males in a group. Larger females groups will be more attractive target for incoming males only up to a point that the new dominant male can exclude other males and monopolize breeding. In general, male membership in polygynous groups increases significantly with several adult females (Andelman 1986; Mitani et al. 1996b).

- *Litter Size and degree of infant development*

The larger litters are very uncommon (Leutenegger, 1979) among primates and usually it differs between one and four and in the wild it rarely exceeds two (Leutenegger, 1979; Chapman, Walker and Lefebvre, 1990; Kappeler, 1998). The size of litter is generally correlated with degree of infant development at birth as infants are born with closed eyes and are unable to grip and climb and where infants are alert and able to cling from birth (Martin and MacLarnon, 1985, 1988; Martin, 1990) and since it is difficult to leave them in a place alone primates generally are selected for single infants so that they are carried from birth by an adult, usually the mother (Kappeler,

1998). Hence different mode of infant care have important consequences for behavior of caregivers and in turn social organization which are: 1. If the infants are left in a shelter it constrains the ranging of lactating females, and 2. The presence of parked young ones diminishes the chance of lactating females to form cohesive groups (van Schaik and Kappeler, 1997). Due to these reasons it suggests that singleton young may have been necessary for the evolution of permanent groups in primates.

- *Reproductive rates*

Since we know that primates have slower life histories than other orders the deceleration of female reproductive rates has a direct effect on the operational sex ratio (OSR), and thus on the mating system. The opportunity for sexual selection is determined by OSR (Clutton-Brock and Parker, 1992) and higher OSR's impart greater opportunities for sexual selection on males and species with longer inter birth intervals have higher OSR's. Moreover male to female ratio as well as number and length of estrous periods also determines sexual selection. For example, the species that forms one male group have low OSR's (Rajpurohit, Sommer and Mohnot, 1995; Watts, 2000). Male maturation time also effects OSR and thus one male groups have longer maturation times (Pereira and Leigh, 2003) biasing the sex ratio towards females (Alberts and Altmann, 1995; Leigh, 1995), and in multi male groups, it is the vice versa. Each pattern reflects female mating tactics, which evolve partly in relation to infanticide risk (van Schaik, van Noordwijk and Nunn, 1999) and hence the best predictor of intensity of male-male competition may be female reproductive rate.

- *Extended juvenility*

Primates have life histories that include months or years during which individuals are independent but infertile members of their social groups because primate somatic growth is slow (Case, 1978; Kirkwood, 1985) and because juveniles depend on experience to refine their basic behaviors (Poirier and Smith, 1974; Janson and van Schaik, 1993). Hence primate group living might have evolved principally as a mechanism to safeguard vulnerable, inexperienced, slow developing juveniles (Pereira and Fairbanks, 1993; van Schaik and Kappeler, 1997; Janson, 2003). The development of sex typical behavior (Pereira, 1988b; Edwards, 1993) and development of affiliative or adversarial social relationships (Silk et al., 1981; Pereira, 1988 a; Fairbanks, 1993; Pereira, 1995) by juveniles affect the social systems as a whole and increase the chance of eventual adult success in juveniles (Fairbanks, 1990; Fairbanks, 1993), and the single most prominent behavior play appears pivotally linked to aspects of neuronal development (Pereira and Leigh, 2003). Long juvenilities and large groups enhance prospects for the evolution of plasticity of physiology and behaviour by ensuring the individuals within populations to encounter wide variety of possible conditions during development (Pereira and Leigh, 2003) and in return information on taxonomic variation in such plasticity (Lee and Kappeler, 2003) will shed light on questions about primate phylogeny.

- *Adult life span*

Primates have relatively long life spans with variations shown across the order (Austad and Fischer, 1992; Allman, McLaughlin, and Hakeem, 1993) and these long lives can be associated with some social complexity since long lived species have more time to differentiate their social relationships.

The need to manage social relations over many years may have selected for increased cognitive capacities (Cheney, Seyfarth, and Smuts, 1986; de Waal, 1991; Byrne, 1995; Dunbar, 1998; Dunbar, 2003). In turn, they would have shaped maternal adjustments across reproductive efforts (Fairbanks, 1988), grand mothering (Hawkes et al., 1998; Hawkes, O'Connell, and Blurton Jones, 2003), tradition and culture (McGrew, 1998; van Schaik, Deaner, and Merrill, 1999; Whiten et al., 1999; Tomasello, 2000; Kappeler and Pereira, 2003).

Social systems in animals

Theory of inclusive fitness states that an organism can improve its overall genetic success by co-operative social behavior (Hamilton, 1964). Hence several animal species from simplest to complex forms tend to lead a social life which is probably a complex and effective survival strategy. Primates, especially higher primates, form complex social systems since their neural systems are highly developed and they respond to the environmental heterogeneity.

Genotype and environment interact with each other producing a phenotype, which determines the adaptability of a species and ultimately the evolution of a species. Whereas the extent and the rate of evolution are determined by the genetic background, the direction of evolution is mainly driven by the ecological forces (Harmon et al, 2009; Nevo, 2001; Badyaev, 2000). Hence both biological and ecological factors together determine the evolution of a species and especially that of social systems.

Social systems are formed by a group of conspecific individuals related to each other through persistent constant interactions (Thierry *et al* , 2004).

The defining characteristics of a social system mainly focus on characteristics of a group and not on individuals (Rowell, 1993). But, it is understood that fitness relevant behavior of individuals like foraging, predator avoidance, mating and parental care also plays an important role in functioning of the social systems.

. During the last 30 years or so, a lot of attention had been paid to study the role of ecological factors in shaping up social systems in organisms and several general principles have been worked out (van Schaik, 1983; van Schaik & Noordwijk, 1986; Rosenberger, 1992; Di Fiore, 2003; Snaith & Chapman, 2007; Schino & Aureli, 2008; Chapman & Rothman, 2009). For example species inhabiting denser forests tend to be more solitary whereas those in open habitats tend to be more social. Particularly, in primates since the social systems are complex and variable (van Schaik, 1983; Di Fiore & Rendall, 1994 ; Kappeler & Schaik, 2002), much effort is needed to solve the intricacies of social evolution. However, in general socio ecological theory (van Schaik, 1989) suggests that the distribution of females and patterns in their behavior are largely governed by the resource distribution and the distribution of males is largely governed by the distribution of the females. The factors such as resource distribution, resource abundance and predation pressure are also known to have an influence on the social structures (Dunbar, 1988; Janson & van Schaik, 1988) and hence we can infer that environment in a direct way or indirect way affects all the individuals and their relationship patterns in a social system leading to differences in social systems in different habitats and across species.

Individual behavior

<https://assignbuster.com/evolution-of-behaviour-in-animals-and-humans/>

Feeding ecology and social organization seldom play important roles in predicting differing responses to disturbance. High value habitats are likely to impact populations favorably both by increasing birth and survival rates, and reducing maturation ages. However, habitat quality is a subjective appraisal for species with differing habitat requirements. Species able to either meet or go beyond their nutritional needs in a disturbed habitat are likely to persist (or even increase) in forest fragments, while those that cannot diminish as a result of nutritional stress (Chapman et al. 2006).

Socio-ecological theories predict that females adjust their social behaviour to their environment (Wrangham, 1980; van Schaik, 1989). On the other hand, as a result of phylogenetic inertia, social behaviour may be slow to hold up when the environment changes (Thierry et al., 2000). If social behaviour is adapted to the environment, competition and co-operation among females is predicted to reflect the characteristics of food sources. Contest competition both between and within groups is expected to result in alliances among related, philopatric, females.

Individual behavioral plasticity

Concept of phenotypic plasticity

Phenotypic plasticity is defined as the ability of an organism within a particular genotype to change its phenotype in response to environmental change - it represents a significant means by which populations can respond quickly to changes in ecological conditions (Scheiner, 1993; Via *et al.*, 1995; Pigliucci, 2001). Plasticity in life history traits is ubiquitous in animal populations (Pigliucci, 2001) with traits often varying within the lifetimes of

<https://assignbuster.com/evolution-of-behaviour-in-animals-and-humans/>

individuals depending on the conditions they experience (Réale *et al.* , 2003b; Nussey *et al.* , 2005). Different organisms display different ability for phenotypic plasticity; representing that phenotypic plasticity itself can develop and has a significant adaptive value (de Jong, 2005).

Phenotypic plasticity is an environmentally based change in the phenotype. When environments within the range of a species differ, it may be unlikely that any single phenotype will confer high fitness in all situations. In such a case, a change in the phenotype that depends on the environment (phenotypic plasticity) can provide increased environmental tolerance. Phenotypic plasticity is thus one solution to the problem of adaptation to heterogeneous environments.

Behavioral flexibility

Behaviour has long been considered the ' most plastic' phenotypic trait as it is likely to show the quickest response to temporal changes in conditions (e. g. Hazlett 1995). The ability to make appropriate responses to changing conditions, or ' situations' (Sih *et al.* 2004), should clearly be helpful.

However, it is also clear that phenotypic plasticity might be costly to produce or maintain (DeWitt *et al.* 1998). Proximate constraints that might edge behavioural plasticity include constraints on sensory capabilities (' information gathering'), cognitive structure and learning (' information processing') or constraints due to morphological and physiological factors (Hazlett 1995; Dall *et al.* 2004). Such restrictions on behavioural plasticity show to vary between (Brown & Braithwaite 2004) and within the (Wilson

1998) populations, in some situation leading to consistent variation in behaviour between individuals.

Conventional wisdom in animal ecology proposes that species that have the ability to occupy a wide niche are more likely to be successful at invading new environments than species that are highly specialized (Mayr 1965; Myers 1986; Ehrlich 1989; Williamson 1996). Behavioural flexibility has long been thought to provide advantages for animals when they invade novel environments. Behavioral flexibility is adaptive for coping with environmental change (Lee, 1991) and primates' tolerance to environmental change lies in the ability to find, consume, and process sufficient food (Chivers, 1991).