Conception of parental investment as a useful explanation of diverse human parental behavior

Elżbieta Cieplak

ABSTRACT   Parental investment is differentiated on prenatal or postnatal stage (e.g., child neglecting, infanticide, or differences in financial support given to children). Differential treatment of children with reference to their sex is influenced by factors such as the sex ratio, parents' status, number of children in the family, birth order, sex of siblings and children's contribution to family resources. Numerous studies on traditional and historical societies have been conducted but there is a need for research of contemporary, industrial societies.

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Human reproductive strategy is a typical K strategy connected with an investment in a small number of well-adapted offspring and associated with parental care that increases the offspring's chances of survival. It means that parents are forced to expend a lot of time and energy in order to increase their reproductive success through just a few offspring.

The term "parental investment" was introduced by Trivers in 1972. He defined it as "any investment by the parent in an individual offspring that increases the offspring's chance of survival (and hence reproductive success) at the cost of the parent's ability to invest in other offspring" [SIEFF 1990]. In mammals parental investment includes gametes production, gestation, lactation as well as feeding and protection of offspring until they reach maturity. Trivers (after QUIATT & REYNOLDS [1993]) emphasizes that parental investment does not include energy spent on finding a partner, competition connected with courtship and mating. Since the resources are limited, a great parental effort put into one particular offspring decreases the parents' ability to invest in the other offspring. Moreover, improvement of the descendant's fitness affects the parents' chances of survival and fertility, fitness of remaining offspring, and sometimes even of other relatives [CLUTTON-BROCK 1991]. Suitable, but not necessarily conscious, decisions as to which of the offspring should be chosen as the most beneficial one result in the parents' higher reproductive success. No wonder that different prenatal and postnatal mechanisms of coping with these problems have developed in the course of evolution.

Department of Anthropology
University of Wrocław
Kuźnicza 35, 50-138 Wrocław

Mechanisms causing diversity in parental investment

Diversity in parental investment in children of both sexes can occur both before and after birth. Prenatal bias, which can be observed as an abnormal sex ratio at birth, can be caused by a variety of mechanisms: different production of sperm with X and Y chromosome, different sperm activity and mortality, differences in implantation and survival of male and female zygotes, different frequency of spontaneous abortions of male and female fetuses. In some non-human primates (e.g., macaques) as well as in human societies the abortion sex ratio is very high in disadvantageous and stressful circumstances, due to higher susceptibility of male fetuses to unfavorable conditions [CLUTTON-BROCK 1991].

The postnatal change in the sex ratio results from the infant's physiological reactions to variable environment or from parents' diverse behavior towards offspring of different sex. According to CLUTTON-BROCK [1991] the sex characterized by faster rate of growth, longer period of development and higher demand for nutrients is more liable to harmful influences. Due to such greater environmental sensitivity of males, the parental investment in this sex can be stopped when mother's condition and environmental circumstances are not good. From the evolutionary point of view it is adaptive not to invest in more expensive sex in such a case. This is especially distinct in birds and mammals with sexual dimorphism [CLUTTON-BROCK et al. 1985]. Although CLUTTON-BROCK [1991] argues, that differential environmental sensitivity of offspring and different parental behavior forced by

offspring (e.g., sucking frequency) should not be treated as part of parental investment, in my opinion, physiological mechanisms, e.g., mechanisms responsible for environmental sensitivity, should be treated in the same way as the behavioral differentiation of parental investment. Both of them can cause the sex differential postnatal mortality of offspring, which can result either from:

• environmental sensitivity (e.g., observed in many mammals and birds fall of the sex ratio after birth, especially in the situation of food shortage [CLUTTON-BROCK 1991]);

• neglecting of offspring of one sex [BOON 1988, VOLAND 1988, CRONK 1989, VOLAND & DUNBAR 1995, SIEFF 1990];

• offspring abandoning (according to Maynard-Smith [SIEFF 1990] it is beneficial only if it occurs after a very small fraction of total investment)

• selective infanticide [HILL & KAPLAN 1988, HRDY 1990, SIEFF 1990].

Parents can discriminate against their male or female offspring also in other ways, which do not lead to the offspring's death. All of these ways have been observed in some populations:

• differences in the amount of food provided to individual offspring, depending on their sex (e.g., KAPLAN & HILL [1988]);

• differences in the duration of the lactation period and the sucking frequency [CRONK 1989, GAULIN & ROBBINS 1991];

• differences in medical care [CRONK 1989];

• differences in financial support given to children in a later period of their life, such as bride-prices [HARTUNG 1982, BORGERHOFF MULDER 1987], inheritances

– land, money [SMITH *et al.* 1987, HRDY & JUDGE 1993] and dowries [BOON 1988, SIEFF 1990];

• different strength of the bond and frequency of interactions between parents and children of one sex [BETZIG & TURKE 1986].

It should be stressed that, depending on the socio-economic status of an individual, the form of parental investment can vary even in one society. HEWLETT [1988] has reported that among the Aka Pygmies, a man enjoying a high status invests time in interactions with other men, whereby he secures his status in order to increase his reproductive success. A man whose status is low spends more time directly with children.

It is quite obvious that there are a lot of ways, which allow parents to discriminate against their offspring depending on their sex. As a result, they can increase their reproductive success. What is surprising is that discriminating against offspring of one sex parents can increase the number of their grandchildren, even if the discrimination resulted in a decrease of the number of their own children.

Factors which differentiate parental investment in both sexes

Pianka & Parker (after VOLAND [1988]) argue that decisions concerning parental investment depend on the reproductive value of the parents and their potential offspring. Fisher (after VOLAND [1988]) defines reproductive value as the statistical possibility of an individual's genetic participation in a gene pool of the next generation. This value changes throughout the lifespan. The parent's reproductive value depends on his/her future life prospects. Since this value decreases with age, parents are prone to invest more in offspring born at the end of their reproduction period [VOLAND 1988]. In many animals, young individuals, with high reproductive value, try to invest as little as possible in their first offspring. Firstly, this is so because inexperienced parents expend more energy on parental care than mature parents; secondly, due to the fact that too early parenthood can prevent them from reaching maximum size, and lastly because death caused by their involvement in the reproduction is more costly for these individuals than for older ones [CLUTTON-BROCK 1991]. The offspring's reproductive value is influenced by the magnitude of variance in the reproductive success of a given sex and it is connected with the structure of reproduction in a population, differentiation of an individual stratum and demographic patterns [VOLAND 1988]. Correct estimation of the reproductive value of the parents and their potential offspring can secure higher reproductive success.

How does a population's sex ratio influence parental investment?

According to Fisher (after TRIVERS [1985]), parental investment depends on the sex ratio in a population. In a majority of species populations consist of a similar number of males and females, because on average each sex brings their parents the same benefits. This means that regardless of the sex of offspring an average number of grandchildren would be the same. This strategy is evolutionarily stable (Maynard-Smith – after GAULIN & ROBBINS [1991]). If this ratio

is unsettled, e.g., if males were only one third of a population, they would have three times greater reproductive success than females, so they would bring their parents threefold return of costs. In such a case an individual which produces more sons would be promoted and his/her genes would spread quickly in the population, causing an increase of the number of males until the optimal sex ratio (one male per one female) has been reached. The situation would be similar if females were one third of a population [TRIVERS 1985, SIEFF 1990]. This mechanism makes the 1:1 sex ratio so common in nature.

According to Fisher's theory, the future reproductive success of a male in relation to the reproductive success of a female depends on the sex ratio at birth. If males outnumber females, an average male has a smaller chance to fertilize a female, and, in relation to the female, a lower reproductive success. Low sex ratio (lower than one hundred[1]) results in a high future reproductive success of the male. Because every individual has to have a mother and a father, total reproductive success of males and females within a population is equal, but, as pointed out by Clutton-Brock and Albon (after SIEFF [1990]), it is not equal for individuals.

Total investment in offspring can be described by Fisher's formula:

$$C_m \times M = C_f \times F$$

where:
C_m – cost of male (from gamete production to maturity); M – number of males; C_f – cost of female (from gamete production to maturity); F – number of females.

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[1] Sex ratio is a number of males per one hundred females in a population.

For instance, if a male is twice as "expensive" to raise as a female, it can be expected that it would have twice as big reproductive success. This would happen if at the end of the parental investment period, the sex ratio was 50 (one male per two females). Only in this case the cost of parental care would be balanced with respect to the cost of the "cheaper" sex. Fisher's formula shows that the total energy of all parents in a population allocated to the male and the female offspring is equal. Fisher argued also that mortality occurring after the period of parental investment does not influence the sex ratio at birth. However, this conclusion is true only for a population e.g., if nine out of ten males died, the one that survived would attain tenfold reproductive success. Even in such an extreme case the reproductive success of this population would be still the same as in the case of survival of all of them, and their tenfold lower reproductive success [TRIVERS 1985]. Clutton-Brock and Albon (after SIEFF [1990]) point out that if sex differences in mortality occur after the period of parental investment and they are affected by this investment, selection will promote these parents who, in spite of a risk of loss, invest more in the sex which will be in minority after reaching maturity.

How does socio-economic status influence parental investment?

Trivers-Willard's theory says that natural selection should favor parents' ability to adjust the sex ratio of their offspring according to the amount of resources owned and to the future reproductive success of offspring of a given sex [TRIVERS & WILLARD 1973]. If the variance in the reproductive success of

one sex is greater, e.g., in males in poly-gynous species, and the offspring's success is affected by the parents' condition (especially important is maternal condition, which in mammals influences gestation and lactation), then the parents being in good condition should invest in sons and the parents in poor condition – in daughters. Males in good condition have access to many mates and can outreproduce females. However, females in poor condition outreproduce males being in the same condition (males can have no access to a partner), and give the parents more grandchildren, because females can almost always find a partner, regardless of their condition and rank (Fig. 1). As a result, the variance in the reproductive success of females is not so big. As shown by the experiment of Bateman [HEWLETT 1988], additional mating does not increase females' reproductive success.
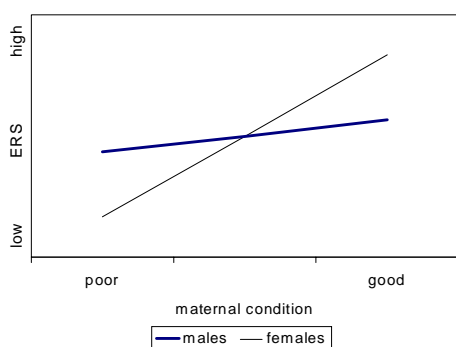

Fig. 1. Relationships between expected reproductive success of offspring (ERS) and maternal condition (after CRONK [1989])

Trivers-Willard's theory is true when the three following conditions are fulfilled [TRIVERS & WILLARD 1973]:
• Offspring's condition has to be correlated with maternal condition (this is true for all species with small litters);

• Differentiation in offspring's condition at the end of the period of parental investment should continue in adult life;
• Mature males do not devote a lot of energy to parental care and their variance in reproductive success strongly depends on insignificant differences in their condition.

Trivers-Willard's theory was based on observation of reproductive behavior of such animals as red deer (*Cervus elaphus*) and rhesus monkey (*Macaca mulatta*). Since in human societies both sexes are engaged to a different degree in parental care and there is also bigger variance in the reproductive success of males than of females, this theory can be helpful to create a new view of the human reproductive behavior. In all known societies, more men than women stay unmarried [GAULIN & ROBBINS 1991]. It is especially the case in polygynous cultures. Furthermore, in most of the cases monogamy is not very restrictive. However, extramarital liaisons augment only men's reproductive output. GAULIN & ROBBINS [1991] argue that there is no significant difference in this respect between women who had and those who did not have extramarital affairs. Additionally, marriage patterns may result in a serial monogamy, which also increases the reproductive success of males. This is so, because men are considerably more likely to remarry and are able to produce children for a longer period of life [HARTUNG 1982, GAULIN & ROBBINS 1991, BUSS 1996].

Both in polygynous societies and in those, which declare themselves as monogamous, socio-economic status and amount of possessed resources secure reproduction. A man has to pay bride-price for a woman in most polygynous

cultures. Therefore, resources are of greater importance for a son's reproductive success [HARTUNG 1982]. This can be observed e.g., among the polygynous Kipsigis pastoralists in Kenya, who have to give cattle as bride-price. The price of a man's first wife is covered by his father. Second marriage (very often after about 10 years) is financed by the husband himself [BORGERHOFF MULDER 1987][2]. In the societies described as monogamous extramarital liaisons concern especially men who have high socio-economic status (they can afford to have a second partner) [HARTUNG 1982]. The studies carried out on the contemporary American population have shown that from 25 to 35 thousand marriages are practically polygynous. As BUSS [1996] states, some of 400 wealthy Americans from *Who is who* revealed that they provided for two separate families.

Further support for Trivers-Willard's theory comes from many studies on historical and traditional hunter-gatherers or pastoralists societies. BOON [1988] during his investigation on the 15th- and 16th-century Portuguese nobility distinguished two different ways of parental investment depending on parents' socio-economic status. The parents who belonged to the highest aristocracy invested in sons (especially first-born). Men from this social stratum had almost twice as big number of offspring as men from the lowest nobility. They had children from extramarital liaisons, were more often able to remarry and according to Boon's hypothesis got married earlier than low-status men. In this social stratum men tended to have higher reproductive suc-

cess than women, but this tendency appeared to be non-significant. In the lower nobility parents invested in one or two oldest daughters who got suitable dowries which were essential to marry somebody from the higher socio-economic class. For the parents from this class the daughters offered a significantly higher chance of having grandchildren. BOON [1988] presents also how differentiation in the parental investment in each social strata became stronger along with increasing number of nobility and competition for difficult to divide recourses (e.g., land). As a result, more and more daughters of high-status parents were removed from the breeding population by entering convents. The cost of that was lower than giving daughters suitable dowries. Moreover, it can be observed that increasing number of sons from the lower nobility perished in numerous wars and in the course of colonisation. Unfortunately, there is no information about the actual value of an estate compared with the cost of dowry and cost of entering a convent in Boon's work. He also did not take into account the reproductive success of the women who married out of this population and those who married into this population and came from other regions, which might have influenced his results [SIEFF 1990].

The importance of the parents' socio-economic status for the parental investment bias is pointed out also in Cronk's studies of the Mukogodo from Kenya [CRONK 1989]. This tribe has recently changed their life-style from hunter-gatherers to pastoralists. Their neighbors, the Maasai and the Samburu have been pastoralists for a long time. Since the Mukogodo own little livestock, do not follow the Maasai's customs and do not

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[2] In general, in such societies the son returns the cost of bride-price working for his parents before he gets married [SIEFF 1990]

have any ancestors from the Maasai or the Samburu, they are considered a group with the lowest status in the area. Like their neighbors, the Mukogodo are polygynous, and men have to pay bride-price before they get married. Due to these factors polygyny rate is lower among Mukogodo men than among men from surrounding tribes. Although they very often give their daughters and sisters to non-Mukogodo men, they can rarely afford to marry non-Mukogodo women. Due to the low status of the population, Mukogodo women on average have significantly more surviving offspring than men, and as a result, parents tend to favor daughters with regard to investment, which can be observed in the sex ratio of children aged from 0 to 4 (98 girls, 66 boys). Since infanticide does not happen among the Mukogodo and the sex ratio at birth is at least 100, differences have to be a result of boys neglecting. Considerably higher mortality of boys occurs in the first year of their life. Furthermore, Mukogodo girls are more often than girls from other tribes and than Mukogodo boys taken to the local clinic, which indicates they are given a better care. SIEFF [1990] argues however, that this can be caused by a different degree of morbidity. Better care for daughters by the Mukogodo can be also observed in some other aspects of their behavior. Their mothers earlier start to participate (and do it more regularly) in the program carried out by the local clinic, concerning education of mothers and fight with malnutrition of children. The visits in the clinic are an investment in terms of time and money. The girls are also breast-fed for a longer period of time. Unfortunately, the data about the reproductive success of Mukogodo men and women concerned

the previous generation and it is not known if in that past generation the bias toward girls was also present [SIEFF 1990].

BETZIG & TURKE [1986] in their study on the Ifaluk from Micronesia also supported Trivers-Willard's theory. They have shown that the parents of the higher status significantly more often associate with their sons than the parents of the lower status who tend to associate more often with daughters. VOLAND [1988] discovered that economic status influenced also the life of half-orphans in the 17th–19th-century North Germany. After the father's death, higher mortality of children aged from 0 to 1 year was observed among sons. There was no difference in the mortality of children of both sexes after the mother's death. This could be caused by a very strong deterioration of the economic status of the family after the father's death (in these families the father was the main resource provider), which resulted in the decline of investment in the sons.

Very complex economic, demographic, cultural and ecological conditions were present in the 19th-century India where the families with the highest status invested in sons whose reproductive success was increased due to polygyny. Their daughters were very often killed after birth or stayed in celibacy. The value of a daughter decreased with the growth of the family status, because the parents had to give a proportionately higher dowry. In the lower part of the elitist caste the investment in dowries for daughters was beneficial, since they were a group from which the families with the highest status chose wives for their sons. For women from the lower part of the elite hypergamy results in the increase of

the reproductive success due to polygyny of their sons [HARTUNG 1982, SIEFF 1990]. In the lowest castes parents earned the bride-price [HRDY 1990, HRDY & JUDGE 1993]. They also made profit from their daughters' work e.g., in road construction or in agriculture. Nowadays, these opportunities no longer exist and even in the poorest, landless castes the increase of daughters mortality is observed e.g., abortion after the identification of the sex of fetus concerned only daughters [HRDY 1990].

How do the number of children, birth order and sex of the other offspring influence parental investment?

The relationship between the number of children, birth order, the sex of the previous offspring and the parental investment is based on cooperation and competition for resources or mates. If brothers could support each other and increase their fitness or chance to find a partner, women who gave birth to a son would profit by giving birth to sons rather than to daughters. This can be observed among the Aka Pygmies where brothers form a unit of hunters and as a result are preferred by women due to their better economic condition. These men do not travel as far as other men to find their wives, marry earlier and are more likely to become village leaders and improve their status [HEWLETT 1988]. Similarly, among the Yanomamo Indians close relatives support one another during fights, which means that an individual having brothers has a better chance of survival. Men who have brothers have also a better chance of acquiring a mate. Like other close male relatives they influence a man's reproductive success. This phenomenon can be the reason of

the high birth sex ratio among the Yanomamo [SIEFF 1990].

In fact, competition among siblings is more frequent than cooperation. From the 17th to the 19th century in Krummhörn (North Germany), where the arable area is strictly limited, the highest mortality of sons occurred in the wealthiest social stratum [VOLAND et al. 1991, VOLAND & DUNBAR 1995]. The birth sex ratio was the highest in this stratum, but the parents neglected the sons after birth. The daughters' mortality did not change significantly in different strata [VOLAND & DUNBAR 1995]. Furthermore, the sons of the wealthiest parents and the sons from two other groups, which possessed land had twice as big chance of not getting married than the sons from the landless group. However, the daughters of the wealthiest farmers had the biggest chance of getting married. This pattern was caused by the inheritance system, according to which only one (the youngest) son inherited the land. The others were paid off and they had to emigrate or to find a wife in a lower social group. Therefore, a big number of sons in the family meant deterioration the household's status. The daughters got only half of the amount given to the sons. VOLAND & DUNBAR [1995] have shown that the number of siblings did not have effect on the mortality of children from the landless stratum, but that the risk of mortality increased drastically in the case of the presence of three or more brothers for a boy and three or more sisters for a girl from the highest status group. Similarly, the number of siblings did not influence the chance of getting married for children from the landless stratum, but the presence of three or more brothers for a boy from the wealthiest group reduced his

chance of finding a partner to less than average for this population. The competition among sisters was not so strong: the presence of three or more sisters for a girl from the highest stratum resulted in a decline of her chances of getting married, but they were still on average level for this population. Furthermore, the probability of emigration was also the biggest for the sons of the wealthiest farmers who had four or more sons.

According to VOLAND [1988] the number of children in the family determined the mortality of half-orphans after father's death in the 17th to 19th-century Germany. In that population considerably higher child mortality was observed when the widow had only one child. The childless widows had bigger chance to remarry, and therefore neglecting of the child was beneficial for further reproductive success of the mother.

How does the offspring's contribution to the family resources influence parental investment?

HILL and KAPLAN [1988] have suggested that among the Ache Indians the high sex ratio at birth (116), greater survival of boys up to 15 years of age and the fact that they are better nourished can be explained by their contribution to the family's food resources. The parents invest a lot in a son and they have to take into account the possibility that they can lose him in warfare. There is no data indicating whether there is a low sex ratio after maturity among the Ache, which could increase males' reproductive success. However, investment in sons is beneficial because from the age of 16 they produce substantially more food than daughters, and because sons marry later and longer contribute to their natal

family [HILL & KAPLAN 1988]. On the other hand bride service is common in this population and it is not uncommon for a daughter to bring a husband to her natal home after marriage, which he starts to contribute to [SIEFF 1990].

Similarly, Smith and Smith (after SIEFF [1990]) in their study on the Inuit explained why in spite of a significant male bias in childhood (119) and longer period of effort invested in sons, similar number of girls and boys survive until maturity. In this case, according to Fisher's theory, the cost of son can not be compensated by his higher reproductive success. Smith and Smith argued that the cost of son could be returned, because sons provide the family with the game they hunt. Since meat is the staple food of the Inuit, a son's contribution increases the family's reproductive success.

HRDY and JUDGE [1993] suggested that girl neglecting in Bangladesh is a result of better work opportunities available for sons and diverse productivity of children of both sexes. Farmers' sons start to produce more calories than they need in the age of 10 to 13. Before they are 15 years' old they have compensated the cost of their raising, when they are 21, each of the sons has „paid off" also the cost of one sister. Daughters, even if they start to work very early, do not manage to compensate the cost of their raising before they marry.

Johannson (after SIEFF [1990]) argues that under the influence of European agricultural modernization childhood mortality dropped more rapidly for boys than for girls. Johannson explained that modernization improved work opportunities for men. As a result

men contributed more resources and needed less parental support before becoming independent. Similarly, in the latter part of the 19th century in Massachusetts [SIEFF 1990] parents biased their investment towards sons in rural regions. In industrial areas women had more opportunities to earn money and they suffered from relatively lower mortality than in rural regions. Fertility analyses in China have also shown that sons are more preferred in rural areas [SIEFF 1990]. Unfortunately, these studies do not include relevant data on the way the parents treated their children, so e.g., Johannson's data can be explained by greater susceptibility of boys who were influenced to a greater degree by the improvement of conditions connected with agricultural mechanization. Actually, only Hewlett [SIEFF 1990] gave detailed analysis of the link between the sex-biased parental investment and the relative contributions of children of both sexes. He suggests that there is a significant positive correlation between the percentage of calories provided by men and the sex ratio of children aged 0 to 15 years in populations of hunter-gatherers. The fact of bigger contribution by men results in boy biased parental investment.

All the studies mentioned in this work have shown that the parental investment can be differentiated by many factors such as a population's sex ratio, parents' socio-economic status, number of children in a family, birth rank, sex of the other offspring, contribution to family resources. Unfortunately, these studies concerned mostly traditional and historical societies and the number of studies on contemporary, industrial societies is much smaller.

Sex of offspring and parental investment in contemporary, industrial societies

There are not many studies on parental investment in contemporary, industrial societies. It might be a result of much more complex relationships between wealth and reproduction success [VINING 1986] or of difficulties with finding appropriate measures of parental investment in such societies. SMITH *et al.* [1993] argue that a transfer of resources can be treated as parental investment which should increase reproductive success of the testator due to augmenting the likelihood of his/her heir's reproductive success. His study of 1000 testators from British Columbia confirmed that they willed their money to the closest relatives, specifically to those who could give them the largest reproductive success. Wealthy testators, in accordance with Trivers-Willard's theory, more often willed their resources to male relatives, the poorer ones – to female relatives (in the group where the value of inheritance exceeded $110 850, the number of male heirs was twice as big as female ones, while in the group that inherited below $20 350, the number of female heirs was twice as big as male ones). What is interesting, in spite of the fact that offspring and siblings were related to the testator in the same degree, the testators more often bequeathed their property to their children. It is probably because offspring have higher reproductive value than siblings, who very often have already terminated their reproduction. Similar results connected with favoring daughters or sons depending on socio-economic status of parents were obtained in other will studies [HRDY & JUDGE 1993].

Different measures were used by GAULIN & ROBBINS [1991] in their study of the American population. They have reported that daughters of mothers with lower income and not supported by the partner are fed longer than male offspring of mothers from the same group. Furthermore, the period before a girl's birth in this group is longer than before boy's delivery. According to RAHMAN *et al.* [1996] children born too soon after the previous delivery might be exposed to higher mortality risk due to shortage of food and care and due to higher morbidity. Women with higher income and supported by the partner biased their investment towards sons [GAULIN & ROBBINS 1991].

BERECZKEI & DUNBAR [1997] have shown that the parental investment in a Hungarian Gypsy population is biased towards girls. Firstly, contrary to the Hungarian population, Gypsies have low sex ratio at birth. Secondly, girls are breast-fed for a longer period of time and their education lasts longer (especially in cities). Lastly, Gypsy women more often decide to abort a fetus when the previous child was a girl, while Hungarian women - when the child was a boy. This bias is explained by benefits resulting from hypergamy of Gypsy women. These who marry Hungarians can increase their reproductive success, because their children during first five years of life are exposed to threefold smaller mortality risk than in endogamic marriages. Children from the hypergamic marriages have also bigger weight at birth and are exposed to a smaller risk of development anomaly. BERECZKEI & DUNBAR [1997] reported that in the Gypsy population daughters gave their parents more grandchildren, particularly in cities where the chance of hypergamy is the biggest.

There is a shortage of data on the parental investment in contemporary, industrial societies. Moreover all studies on these societies refer to the same period of life of offspring. They were connected either with the parental investment in the few first years or with the last will of the parents, an thus usually with the later stages of offspring's ontogeny. There is an exception in the form the study by BERECZKEI & DUNBAR [1997] who took into consideration diverse education of children. This means that there is a need of data from other that American or Gypsy societies and from different stages of ontogeny.

The conception of parental investment presented in many studies on different populations gives us a new point of view on diverse parental behavior and parents' preferences with reference to the sex of offspring. The behavior which results in the enhancement of parents' reproductive success through differential treatment of children according to their sex is obviously adaptive from the evolutionary point of view. A great number of factors, which have effect on such behavior such as different environment of individual populations, diverse prenatal and postnatal mechanisms involved in it makes this behavior very complex and flexible. If we want to fully understand the phenomenon of parental investment, we have to collect more data, especially connected with contemporary, industrial societies and try to include more factors in these studies. There is also a need for a model appropriate for contemporary changing societies. It is worth noticing that anthropologists still insufficiently explore this area.

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Streszczenie

Inwestycja rodzicielska (*parental investment*) to każda inwestycja rodziców w potomka zwiększająca jego szansę przeżycia i rozrodu, kosztem pozostałego potomstwa oraz przeżywalności i dalszej płodności rodziców a czasem także dalszych krewnych. Obejmuje ona produkcję gamet, ciążę, laktację, karmienie i ochronę potomstwa aż do osiągnięcia dojrzałości oraz wsparcie finansowe.

Z powodu ograniczeń w dostępie do zasobów oraz wysokich kosztów inwestowania w potomstwo, rodzice muszą różnicować inwestycję wybierając płeć, która zmaksymalizuje ich sukces reprodukcyjny. Mechanizmy różnicujące

mają miejsce w okresie prenatalnym (różna produkcja plemników z chromosomami X i Y, różna ich ruchliwość i śmiertelność, zróżnicowana przeżywalność męskich i żeńskich zygot i płodów) bądź postnatalnym (zaniedbywanie, selektywne dzieciobójstwo, zróżnicowanie odżywiania (w tym długości laktacji), opieki lekarskiej, wsparcia materialnego oraz różna siła więzi i częstość interakcji rodzice-dzieci). Odpowiednie, co nie znaczy świadome, decyzje pozwalają na zwiększenie sukcesu reprodukcyjnego rodziców.

Istnieje wiele czynników wpływających na zróżnicowanie inwestycji rodzicielskiej. Jednym z nich jest proporcja płci w populacji. Fisher podkreślał ewolucyjną stabilność układu o zbliżonej liczba samic i samców. Z drugiej strony teoria Fishera przewiduje, że sukces reprodukcyjny danej płci zależy od proporcji płci w momencie urodzenia.

Teoria Triversa-Willarda uwzględnia inny bardzo istotny czynnik jakim jest ranga i kondycja rodziców (u człowieka – status socjoekonomiczny (SES)). Jeśli wariancja sukcesu reprodukcyjnego jednej z płci jest większa np. płci męskiej w związku z zachowaniami poliginicznymi, a sukces reprodukcyjny potomstwa zależny jest od kondycji rodziców, rodzice o wysokim SES powinni inwestować w synów, natomiast rodzice o niskim SES w córki.

W populacjach ludzkich istotna jest również dzietność rodziny, kolejność urodzenia, płeć pozostałego potomstwa, które wiążę się ze współpracą lub konkurencją między rodzeństwem lub innymi członkami rodu. Oczywiście „tańszą” płcią jest ta, która zaangażowana jest we współpracę. Znaczny wpływ ma również możliwość zwrotu kosztów zainwestowanych przez rodziców w dziecko dzięki pracy dziecka i dostarczaniu zasobów rodzinie.

Oddziaływanie poszczególnych czynników zostało prześledzone w wielu pracach dotyczących społeczeństw historycznych oraz tradycyjnych jak łowcy-zbieracze czy ludy pasterskie. W artykule przedstawione są również stosunkowo nieliczne prace dotyczące współczesnych społeczeństw przemysłowych.