Wise exploitation – a game with a higher productivity than cooperation – transforms biological productivity into economic productivity.

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Abstract

I suggest a new game called wise exploitation. It is characterized by a small investment of the exploiting party to either breed the exploited party or educate the exploited party not to detect exploitation. Thereby a higher productivity than cooperation or prisoners´ dilemma is achieved. The higher productivity is a benefit for the group and one party on the cost of the other. To stabilize this an important marginal condition has to be met: the investment (breeding, education) must be overcompensated by the gain. In the light of this suggestion mutualism or symbiotic associations of genetically non related organisms, like leafcutter ants with their fungus or human groups should be reinvestigated.

Keywords

wise exploitation – cooperation – prisoners´ dilemma – breeding – education – leafcutter ants

Abbreviations

b benefit, c cost, e education, h hope, br breeding

Introduction

In 1999 Turner and Chao (Turner and Chao, 1999) investigated a case of prisoners´ dilemma in an RNA virus. As a result of their investigation the payoff matrix could be filled with real fitness values. The experimentally determined fitness values taught an example of prisoners´ dilemma. In prisoners´ dilemma selfish, not related individuals do not cooperate (1-c), because the loss is smaller than the loss by exploitation ($1-s_1$). This behaviour harms the productivity of the population (both together). It is up to now generally accepted that cooperation of groups and individuals is the most productive behaviour. Turner and Chao observed in their experiment a transitory higher productivity of the phage ensemble in the beginning of their experiment (Turner and Chao, 1999), the same experiment that finally would lead to prisoners´ dilemma. From this observation and the determined fitness values it is clear that a higher productivity than cooperation is possible; $(1+s_2)+(1-s_1)>2$. How could this high productivity be stabilized? The answer to this question leads to a hypothetic new kind of game called wise exploitation. In this game a higher productivity than cooperation is achieved through exploitation. As productivity is a very important aspect of fitness this hypothesis could influence the present day view of symbiosis and mutualism as well as human culture, civilisation and economy. This paper has been published as patent application DE 10 2006 028 315 A1 2006.12.14.

Prisoners´ dilemma

For the basic concepts of game theory and the general model the reader is referred to

Renaud and deMeeüs (1991), Smith (1976), Turner and Chao (1999) and Turner (2003). Prisoners´ dilemma is defined by the condition $(1\text{-}c)>(1\text{-}s_1)$. The payoff matrix in the experiment of Turner and Chao has the following values: If both parties cooperate, the fitness value equals 1. As soon as one party defects while the other party cooperates, the exploited, cooperating party suffers a loss of $1\text{-}\ s_1$ (0.65) and the exploiting, not cooperating party has a win of $1+\ s_2$ (1.99). If both parties do not cooperate the loss for both is 1-c (0.83).

The balance for the population (both parties) looks different. In the case of cooperation the system has a productivity of 2 (1+1). In the case of exploitation the productivity of the system is 2.64 ($1\text{-}\ s_1$ (0.65) + $1+\ s_2$ (1.99)). This is clearly better than cooperation, but does not last long as the exploited party is soon lost, as observed by Turner and Chao. The system has the lowest productivity when both parties do not cooperate; 1.66 (1-c+1-c). This is a clear example for prisoners´ dilemma. The decision of an individual party to cooperate or defect depends on the relation of 1-c and $1\text{-}s_1$. If $(1\text{-}c)>(1\text{-}s_1)$ the single party will not cooperate because the loss in defect is smaller than the loss by exploitation. This however will cause a loss in productivity for the population as a whole. Prisoners' dilemma is a conflict between the aim to maximize productivity either for the individual or the population.

Tolerated but limited exploitation

If $(1\text{-}c)<(1\text{-}s_1)$ the exploited party tolerates exploitation because exploitation is still earning more than defect. Though not necessarily identical, s_1 and s_2 are coupled. The gain for the exploiting party $(1+s_2)$ will never be big, as the size of $(1\text{-}s_1)$ is limited by the size of (1-c). In other words: $s_1<c$. The gain of the population is based on the difference of s_1 and s_2. In case the fate to exploit or being exploited is not randomly distributed between both parties the always exploited party will vanish by extinction through the additional load in repeated games. As the exploitability is confined by the size of c this condition is not further considered. Brute force is not included in this condition. A detailed analysis of brute force follows in the discussion. Forced mutualism and manipulation are discussed in a review on cooperation in non-kin (Clutton-Brock, 2009). Manipulation of partners leads to the next point.

Wise exploitation

The experimentally determined fitness values (Turner and Chao, 1999) 0.65+1.99=2.64 clearly show that the population (both parties together) can earn more than in the case of cooperation. However, this is not stable as the party suffering the loss s_1 will be lost by consumption or by extinction in repeated games if the fate of being exploited is not randomly distributed between both parties. In intelligent species the exploited party will detect exploitation and then try to escape the exploitation. This would then always lead directly to prisoners´ dilemma. Two possibilities exist to avoid the loss of the exploited party.

First case: $(1+s_2-br)+(1-s_1)>2$ if ($s_2-br-s_1>0$; farming)

The exploiting party invests in breeding (br) of the consumed party. Therefore, the win s_2 is slightly decreased. As long as the costs for breeding (a sustainability factor) are much smaller than the gain s_2, the productivity will be higher than cooperation. Though the exploited party will be consumed, it is replaced by a new generation of exploitable individuals.

Second case: $(1+s_2-e)+(1-s_1+h)>2$ if ($s_2-e-s_1>0$; culture)

In this case the exploiting party invests in education (e) of the intelligent but exploited party not to detect exploitation through a mechanism called hope (h). Hope is induced by education to assess the loss ($-s_1$) not as a loss but even a win. As long as education is cheap ($e<s_2$) and successful the ensemble is stable and more productive than cooperation. Hope (h) is not included in the limiting condition $s_2-e-s_1>0$, as hope is virtual. If breeding and education will fail the system will immediately change to prisoners´ dilemma, because we still are in the condition $(1-c)>(1-s_1)$.

Discussion

Is wise exploitation observable in reality? In organisms the benefit (b) of an action must outweigh the cost (c) of this action; b>c. The ratio b/c is maximized in economics and biology (Fong, 2005). The benefit may be completely used by a second organism if this organism is genetically related (b*r>c) (Hamilton, 1964, Smith, 1989). This is called altruism. This genetic relation will guarantee that the altruistic gene will not be lost. Altruism is always genetically founded (Smith, 1989). Mutualism and symbiosis are forms of intimate interaction between non related organisms. This kind of cooperation is generally viewed as beneficially for both parties. In recent years a discussion has started how costly mutualism may be (Bronstein, 2001). An example of mutualism is the interaction between leafcutter ants (Atta, Acromyrmex) and a fungus (Leucoagarius gonogylophorus) grown in their garden. The ants collect plant material (leaves) and bring it into specialized chambers of their nest. There they inoculate the plant material with the fungus. The fungus grows and the ants harvest special parts of the fungus (Weber, 1966). In case the fungus would really benefit from this interaction I would expect the fungus to colonize new nests by sheer productivity gained from the ant-fungus “cooperation”. But the queens usually have to take the fungus with them when founding new nests. In addition, the fungus is only found in nests and it seems that there are only cryptic rests of sexual reproduction (Mikheyev et al., 2006). Sexual reproduction is usually a good indicator for metabolic surplus. Many organisms with parasitic load cease or stop reproduction and some invest only in body mass (Moller, 1993, Wilson and Denison, 1980). In the light of the presented hypothesis I would judge that the fungus is exploited by the ant. On the other hand the attine ants really benefit from this interaction. They form the largest colonies of all ants (Hölldobler and Wilson, 1990). The increased productivity is solely consumed by the ant partner. The fungus can´t escape because the ant controls him and his propagation. The ant breeds the fungus and the fungus does not become extinct. The fungus is so week through this exploitation that it is easily overgrown by other fungi (Escovopsis). Therefore, the ants have to invest additionally in antibiotic management (Cameron et al., 2003). The fungus is not able to influence the interaction for his purpose (Mehdiabadi et al., 2006). Could wise exploitation be a route to group selection?

In intelligent species like man exploitation will be easily detected by the exploited party. Therefore, all human societies have means to educate (e) for hope (h) that there is a better ending of the exploited party. Hope (h) is a function of education (e). As hope (h) decreases the detectable size of the loss (s_1) the intensity of education (e) (indoctrination) has a big leverage effect. Hope is a complex of induced feelings, affects and emotions (from love and pride to hate and contempt and all feelings in between) used to educate and influence the behaviour of the addressed and educated person on the short and long run. The importance of emotions in human cooperation has already been addressed (Fessler and Haley, 2002). The reward comes not from a fair share but probably through an educational conditioning of the brains own neuronal and endocrinal reward system. The involvement of mirror neurons in emotions and wise exploitation would be no surprise (eg to fight and die heroic as a soldier under a heroic acting general). Big parts of different cultures deal with role models and stories about suffering and happy ending (from rags to riches, per aspera ad astra (Seneca)) with medals of honour and monuments for the dead as a good example for the living and with philosophic construction of altruistic relationships of biologically unrelated persons. The exploiting party could be called cultural elite. The terminus culture but not civilization has been chosen for the second case. A civilization makes combined use of different cultures: agri-culture (farming, the first case) in combination with military culture, scientific culture, religious culture etc. to further increase the productivity of the ensemble and would be an additional case. But all this should be discussed elsewhere in detail.

Footnote: Third case civilization

$(1 + s_2 - br_{plant} - br_{animal} - br_{man} - e_{a+b+c+...z}) - e_{pol} + (1 - s_1 + h_{a+b+c+...z}) + h_{pol} > 2$

if: $s_2 - s_1 - (br_{all}) - (e_{all}) > 0$

Civilization combines the exploitation of different cultural practices (agri-culture, military culture, religious culture, scientific culture, etc). The political elite may be a dominant cultural elite (eg religion) or new. A political elite educates (e_{pol}) cultural elites to tolerate their exploitation for “higher” aims (h_{pol}). In economically highly productive societies br_{man} (biological productivity) may fall under a critical value. Immigration may here be used to restore the necessary exploitable individuals.

The size difference of $s_2 > s_1$ pays breeding and/or education and probably a reward. This asymmetry needs an additional explanation. At the first glance it is surprising that the transfer of a substrate from the exploited party to the exploiting party will result in different values. The reason is enzyme kinetics. The substrate is moved from a saturated enzyme to an unsaturated enzyme where a better b/c ratio exists (b/c>1). The relative increase in reaction rate (productivity) is better in the unsaturated enzyme. If $s_2>s_1$; the situation could be called productive exploitation. One party and the group will benefit. The gain might be shared with the exploited in a way that parts of the gain are used to breed or educate the exploited party. The reward will be smaller but will last longer. Then one should call this productive wise exploitation or wise exploitation. If $s_2<s_1$; this can be called consumptive exploitation. Here only one party but not the ensemble as a whole gains. Breeding and education may also be used here but it is not wise (but it could be called clever). This will not be self sustaining as productivity is wasted and b/c<1. The graphs “substrate concentration versus reaction velocity” in enzyme kinetics and the shapes of “cost versus benefit” graphs in economy look very much alike. The shape of these and similar graphs (a steep part at small x values followed by a flat part at high x values) is a key to understand a build in conflict – velocity, potential and adaptability or strength and stability. The conflict over the direction of the transfer is resolved in parent-offspring relation - altruism.

The relation between cooperation, productive exploitation, (productive) wise exploitation, tolerated exploitation, consumptive exploitation and prisoners´ dilemma are mapped in Figure 1.

Figure 1.

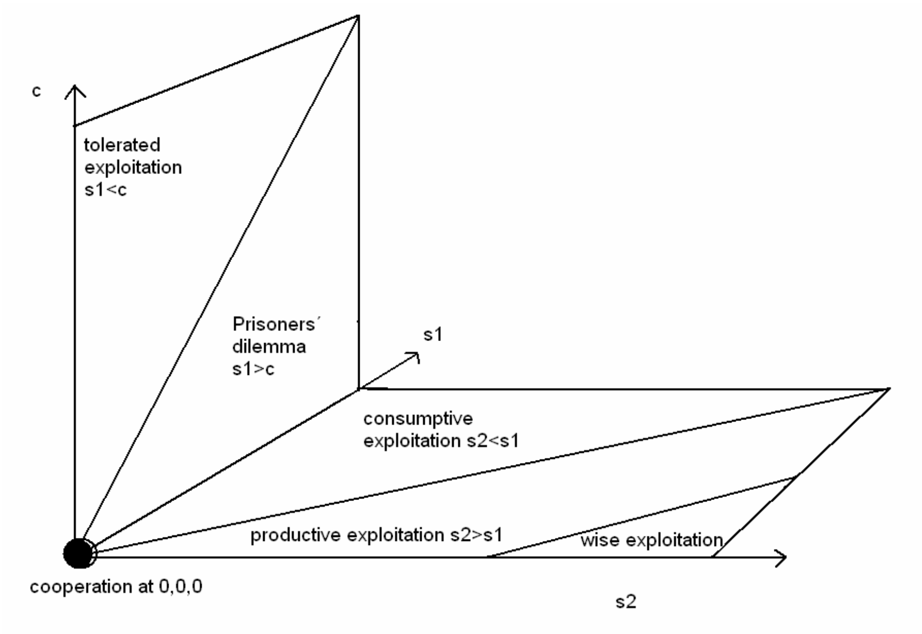

Figure 1: Reducing the (detectable) size of s_1 is a way to go from prisoners´ dilemma to tolerated exploitation. An alternative route is the increase of c by brute force. Then tolerated exploitation is changed to forced exploitation (see later). Taking more and more (increase s_1) will pave the way from tolerated exploitation to prisoners´ dilemma.

Insufficient attention (increase the cost of "giving (s_1)" or decrease the value of "receiving (s_2)") at given cost of breeding and education is the way to go from (productive) wise exploitation through productive exploitation to consumptive exploitation. The border between productive exploitation ($s_2>s_1$) and (productive) wise exploitation ($s_2>s_1$+br or e) is where the additional cost of breeding, education and reward are fully paid by the gain through productive exploitation.

Cooperation is possible when c, s_1 and s_2 are zero. The cost for the population is 2c. The productive slice for the whole population is s_2-s_1-2c>0 in a cubic space formed by c, s_1 and s_2. Group selection is possible in the subspace s_2-s_1-2c-br>0. Whether the cost c is really of the same size for both parties needs to be discussed and awaits experiments.

Beside the asymmetry $s_2>s_1$ an additional point has to be discussed: Why should the exploited party interact at all? The loss will be either s_1 or c. The best alternative for a selfish entity would be to avoid any form of interaction. Where does the advantage hide? Both variables are costs; c is a fix cost, a general cost also present if the transfer is not realized. The cost s_1 of the exploited party includes besides the fix cost (c) the cost for lost substrate (S) and the loss in productivity (p) with this lost substrate. The substrate cost is a linear function. Increasing the amount of a substrate by a factor of two will double the total substrate costs. This is typical for a variable cost. The productivity with this substrate is a saturation function due to enzyme kinetics (Michaelis-Menten). A doubling of the substrate concentration at already high substrate concentration does not double the productivity. To get rid of large variable costs for the price of a small loss in productivity at high substrate saturation is the only reason to be willing to take part in a transfer.

The cost c is a fix cost. The cost $s_1=c+p+S$; c fix cost, p productivity loss, S cost of the lost substrate (lost variable cost)

Prisoners´ dilemma has the following logic: $s_1>c$.

This is equivalent to $c+p+S>c$ or $p+S>0$.

To give s_1 would be a big loss. The loss c is accepted.

Tolerated exploitation is $s_1<c$.

This is equivalent to $c+p+S<c$ or $p+S<0$.

As substrate costs are always positive p must be a high negative value. A negative productivity loss is a relative productivity gain in comparison to the residual amount (cost) of substrate. This is the hidden advantage. Therefore a selfish entity is willing to interact. The organism gets rid of substrate not earning its variable cost at given fix cost.

From a pure enzymatic consideration the answer is even simpler. Take two identical enzymes. The first saturated with substrate the second not. The second enzyme has a higher reaction rate. The substrate is taken away from the first enzyme. Give and take determined by rate constants and concentrations – not moral or economic evaluations. This differs from the real economy where there is no secure knowledge.

Brute Force

Brute force is a fact in human and animal societies (Clutton-Brock, T.H. and Parker, G.A., 1995). In prisoners´ dilemma $(1-s_1)<(1-c)$, $s_1>c$, no source (s_1) is available because not helping (c) is cheaper. Brute force (bf) raises the cost of not interacting (c). This will change the size difference $s_1>c$ to $s_1<c+bf$ and therefore $(1-s_1)>(1-(c+bf))$. Now a source (s_1) is available. This condition could be called forced exploitation.

Fourth case: forced wise exploitation $(1+s_2-bf)+(1-s_1+f)>2$ if $s_2-s_1-bf>0$

Brute force is an investment by the exploiting party. It is not necessary for the dominant party to use brute force (bf) all the time as fear (f) has a long lasting effect in hiding the true cost of s_1. Fear (f) is an emotion of the exploited party caused by brute force. Fear is not included in the limiting condition as fear is virtual like hope.

Productive forced exploitation is a condition when the substrate transfer from source to sink will lead to a better productivity ($s_2>s_1$). If this better productivity pays the force and probably a reward it is called wise (productive forced wise exploitation). The combination of “brute force” and “wise” may seem at least surprising. “Wise” refers only to the fact that brute force in combination with fear will prevent that the exploited party is lost (refuse to obey) and that the gain from this forced exploitation pays the force and probably a reward. In this condition the system has a higher productivity. Consumptive forced exploitation is a condition when $s_2<s_1$ and is a waste of productivity as consumptive exploitation. Under consumptive conditions the system (both parties) has a lower productivity. Brute force with fear and education with hope may act synergistically as well as antagonistically.

Honesty and signaling

As brute force honest behavior is also observable (Mougeot, F., 2004). The expression of sexual ornaments has been suggested to reliably indicate individual quality, such as the ability to cope with parasites and diseases. The authors found in their experiments that comb size was not correlated to infection intensity by two parasites but it was significantly positively correlated with condition and T-cell-mediated immunity. Honesty increases the productivity of an ensemble in avoiding a consumptive transfer ($s_2<s_1$).

Summary

The variables c, s_1 and s_2 form a cubic space where all combinations will be possible; c and s_1 are costs. C is always present, a fix cost. C is Janus-headed. On one side it is the fix cost of giving; on the other side it is the fix cost of receiving. This cost may or may not be symmetrically distributed between both parties. The cost s_1 includes the fix cost, the variable substrate cost and the loss in productivity of the exploited party. To reduce large variable substrate costs with a small loss in productivity is the only reason to be willing to take part in a transfer. The gain s_2 is the productivity of the recipient with this substrate, including the variable substrate cost and the fix cost. The transferred substrate is coupling s_1 and s_2 within a three dimensional interaction space.

This block shaped space has three planes with two pairs of variables each. The first plane compares the loss of the exploited party with the size of the loss in case the transfer is not realized: $s_1>c$ (Prisoners´ dilemma, better called avoided exploitation) and $s_1<c$ (tolerated exploitation). The second plane compares the gained productivity with the lost productivity: $s_2>s_1$ (productive exploitation) and $s_2<s_1$ (consumptive exploitation).

This plane is the system view. The third plane (not discussed in the text) compares the cost with the gain of the exploiting party: $c>s_2$ (costing exploitation) and $c<s_2$ (cost efficient exploitation). A productive slice of this space is $s_2-s_1-2c>0$. Group selection is possible in the subspace $s_2-s_1-2c-br>0$. The triangles $s_1>c$ (avoided exploitation) and $c>s_2$ (costing exploitation) somehow mirror each other. $c>s_2$ and $s_1>c$ imply an unattractive gain and an unattractive loss. Similar $s_1<c$ (tolerated exploitation) and $c<s_2$ (cost efficient exploitation) are attractive as direct and indirect benefits are realized. To interpret it even more simple: Both sides (giving and taking) compare benefit (b, productivity output per variable cost c input) and cost (c, total cost of source or total cost of sink). If $b/c>1$ exchange will take place ($s_1<c<s_2$). If $b/c<1$ exchange will be rejected ($s_1>c>s_2$). A path through this space is described in Figure 2.

Figure 2

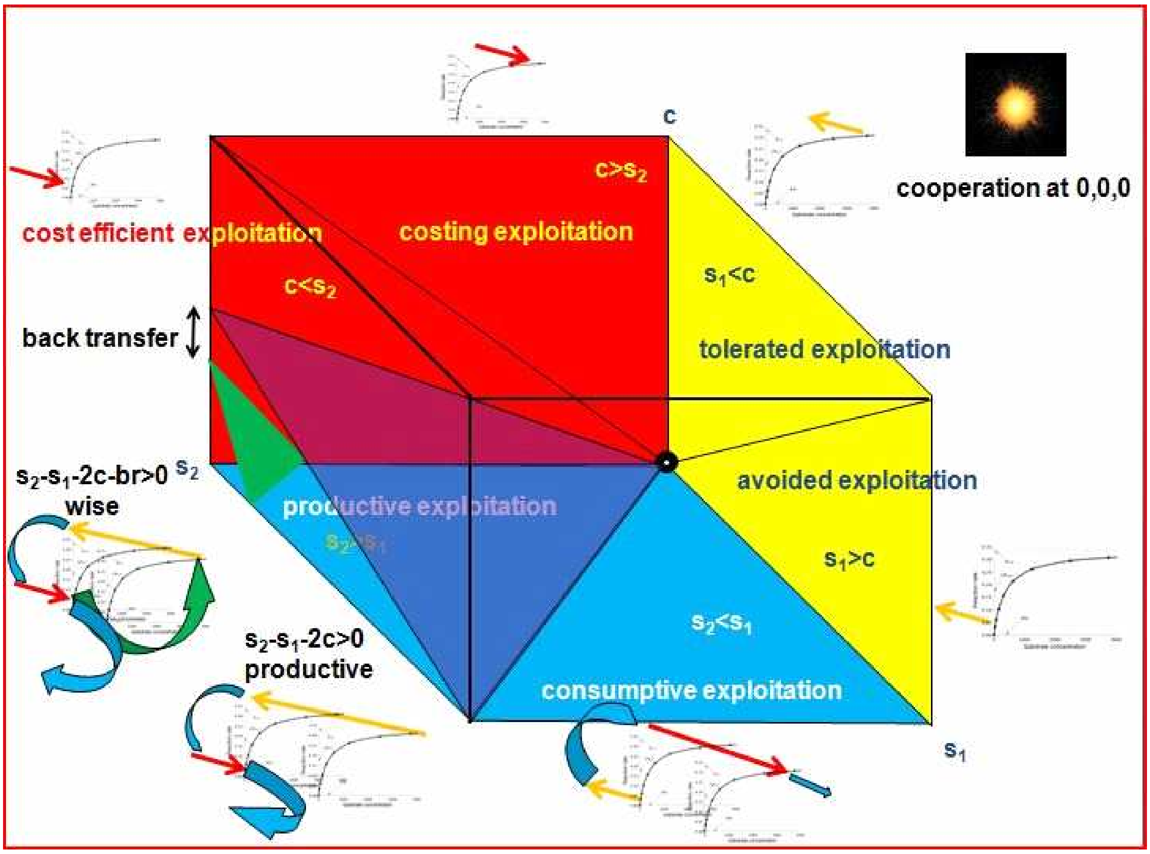

Figure 2. Cooperation with the coordinates 0,0,0 is only the big bang; the entering point to this transfer and exploitation space. A way through this space may have the following route: Starting in avoided exploitation (prisoners´ dilemma, not giving because not saturated) one party invests in brute force to increase c for the other party. The exploited party is moved by brute force to tolerated exploitation (now forced exploitation) and gives to reduce the variable costs that no longer pay. This is costing exploitation for the dominant party (substrate is used by an already saturated enzyme). If the dominant party is able to increase the gain from the received substrate the path leads to cost efficient exploitation (use by an unsaturated enzyme). Now the use of brute force may be decreased (decrease the fix cost c) and the path leads to productive exploitation. This additional productivity may increase further and lead to an earning investment into the stability of the source (exploited party). The small volume of wise exploitation is entered. After a while a mutational subset of dominant individuals does no longer invest into the exploited party. The gain of this subset will increase in comparison to the original behavior. The new exploiting strategy will replace the old strategy. Wise exploitation is changed to productive exploitation in the same spot. The productivity is however only used by the exploiting party. An intra species arms race among the exploiting behavior may begin. The exploited party starts to become exhausted. The efforts of the exploiting party to take will increase and the system moves to costing exploitation. The availability of the exploitable source will further decrease and the area of pure consumption is reached (substrate from an enzyme with good productivity is transferred to an enzyme with bad productivity). After the source is completely consumed we are back in the area of prisoners´ dilemma – not giving - because nothing is there to give.

If the fix cost c is not evenly distributed between both parties (male-female, strong-weak) brute force may be a comfortable way to move the other party from prisoners´ dilemma to tolerated (forced) exploitation without leaving the area of cost efficient exploitation.

As long as the exploited party is consumed or lost the stability of the system depends on the inflow of an exploitable source. This stability is only comparable to the stability of a predator/prey system. Therefore, a mechanism is suggested to stabilize the condition of exploitation. This mechanism is called wise exploitation. The wisdom of wise exploitation is the investment into a stabilization of the exploited party. The investment is paid by the gain through a better productivity after a substrate transfer; $s_2>s_1$. A further condition is that the difference s_2-s_1 is big enough to pay the necessary investment.

Four cases are described:

1. $(1+s_2-br)+(1-s_1)>2$ if ($s_2-br-s_1>0$; farming with breeding br)
2. $(1+s_2-e)+(1-s_1+h)>2$ if ($s_2-e-s_1>0$; culture with education e and hope h)
3. $(1 + s_2 - br_{plant} - br_{animal} - br_{man} - e_{a+b+c+...z}) - e_{pol} + (1 - s_1 + h_{a+b+c+...z}) + h_{pol} > 2$

   if: $s_2 - s_1 - (br_{all}) - (e_{all}) > 0$ (civilization exploiting cultures)
4. $(1+s_2-bf)+(1-s_1+f)>2$ if ($s_2-s_1-bf>0$); forced wise exploitation with brute force bf and fear f

However, the wisdom of the 4 conditions is of different quality. Only breeding (1 and 3) is self sustainable. The wisdom of 2 and 4 relates only to prevent the loss of the exploited party on the short run within one lifetime. Group selection as a long lasting process will only be possible when the exploited party is kept over generations. Under productive conditions ($s_2>s_1$) a part of the gain has also to be invested in breeding of the exploited party to create a long lasting source. But that does not mean kindness. The exploited party is usually dragged behind by brute force and farming – farming is central!

Brute force, education and even breeding may be used when $s_2<s_1$. This will exhaust the system and only work for a very short time. Nevertheless, as long as there will be an

influx of exploitable entities from “somewhere else” also consuming systems may be stable like predator/prey systems. Productive exploitation and (productive) wise exploitation occupy partly the same space. This leads to a known danger in comparing the success of both conditions. Productive exploitation is more earning than wise exploitation in the same spot as the investment (breeding, education and brute force) is absent. If the investment in wise exploitation is reduced the gain will increase but on cost of the ability of the system to regenerate.

The reader may dislike the word “exploitation”. It could be replaced with “transfer” but it must be clear that the value creating process needs a source where a natural process accumulates material and energy. “Nothing will come of nothing: speak again.” (Shakespeare, King Lear) – mass and energy are conserved. Education, brute force, hope and fear are modifiers to overcome the condition of prisoners´ dilemma (not giving) in hiding the true size of s_1. It is important to understand that this does not change the real values. It only will change the behavior of one party from “not giving” (prisoners´ dilemma) to “giving” (tolerated/forced exploitation) because the perception of the relation between fix cost and variable cost including productivity has changed. At a certain size of the real loss (s_1) it will no longer be possible to reach the volume of wise exploitation. Then only productive exploitation or consumptive exploitation will be possible. This will exhaust the exploited party and calls for influx of new exploitable sources.

It should be mentioned not only for reason of political correctness that productive wise exploitation with education is the most productive condition as education is surely cheaper than brute force. Brute force is inducing additional costs on both sides (harm). Brute force is a special case of education (education without words) and fear is a special case of hope (hope not to be punished if helping). The dominant party will use brute force to transfer the other party from prisoners´ dilemma to tolerated exploitation (forced exploitation) but the exploited party may also use brute force to move the dominant party from cost efficient exploitation to costing exploitation – a less attractive condition. The success depends how near the border to the unattractive condition is and whether there is some leverage effect if c is not symmetrically distributed. Tolerated exploitation differs from forced exploitation as brute force is absent. Tolerated exploitation may be as well productive ($s_2>s_1$) as consumptive ($s_2<s_1$) but is always limited ($s_1<c$). Because of this limitation prisoners´ dilemma (avoided exploitation) is a very attractive condition as the fix cost (c) is low compared to tolerated exploitation. Hope and fear hide the true cost (s_1) and change the behavior towards giving at low fix cost although giving is not reasonable. Populations starting from avoided exploitation will enter the volume of productivity cheaper (fix cost) but on cost (productivity) of the exploited party. Cooperation is overestimated! Cooperation (coordinates $c=0$, $s_1=0$, $s_2=0$) is mixed with a point of the following coordinates: $s_2>>s_1$, $c\sim0$, $s_1\sim0$. At this point very much productivity is gained from a minimal (not detectable) loss of the exploited party. If this gain is generously shared with the exploited party an attractive situation is created. Cooperation is only the entry point into an interaction and exchange space. As mass and energy are conserved only a new quality appears at that starting point - but no quantity. The new quantity comes from the transfer of a substrate from a saturated condition to an unsaturated condition. The reverse transfer leads to a loss. In prisoners´ dilemma on one side the population suffers a loss in productivity because the individuals fear exploitation and therefore defect. Is there really much loss in prisoners´ dilemma (avoided exploitation)? Especially in intra species conflicts it is to expect that c is of the same size for both parties and a symmetric loss is realized, this is acceptable as no asymmetric advantage is created. In the case of exploitation the productivity gap has the size of s_1+s_2; this is not tolerable between competitors.

In exploitation one individual or a group of individuals suffer (decreased productivity for their own use) and do not gain adequate for their investment while the exploiting party gains. In addition, the balance shows that the population in total may also gain if the transfer of the substrate from the source to the sink ends in higher productivity ($s_2>s_1$). This condition is stabilized by a reinvestment of the exploiting party either in breeding or in education or in brute force. Breeding replaces the exploited and consumed individuals. Education hinders the exploited party in detecting their own exploitation. Hope for a better life in the future or another world compensates and hinders the detection of the loss. Therefore, this condition also could be called “helpers hope”. If such an education is hiding successfully a high true cost s_1 it is not important for the exploited party whether the exploitation is productive or consumptive – it will never be wise. Brute force makes the exit to prisoners´ dilemma unattractive. Exploitation will not be stable on the long run if it is consumptive ($s_2<s_1$). But even productive exploitation will not be stable on the long run if the exploited party is lost because no investment in the stability is made.

The additional (economic) productivity comes probably from decreased fertility and fitness (pure biological productivity) under the conditions of exploitation. s_1 stays a loss for the exploited party though this loss may gain productivity in the system. In reverse s_2 is a win but sometimes costing. The reward may be shared in a way that the exploited party will not be lost. The danger and the chance for interfering with conditions like that is that upon detection (disappointment of hopes for repayment of the investment in the real world) the system will immediately change from wise exploitation to prisoners´ dilemma. Education and hope may decrease the effect of fear and therefore counteract brute force. Brute force and education may also act synergistically. In appropriate experimental settings exploitation as a stable condition should be easily testable. Finally a more philosophical point: Cultures transform biological productivity into economic productivity. This productivity is no longer lost to pathogens or predators. Two offspring would survive on an average. The rest of the biological productivity is no longer lost to other species but stays within the human species/population as a long living investment product (eg. buildings, territory, knowledge). Thereby the personal suffering of the living may be decreased while the biological productivity suffers a loss. The not existing individuals do not suffer. If a decrease in fertility will lead to investment possibilities lending money and paying interest are also two sides of the coin “wise exploitation”. As living organisms have a typical maximal amount of offspring the economic productivity (maximal offspring amount minus two - immigration not considered) could have a limit. This would mean a speed limit for economic growth for the population may exist. Growth rates in single areas may exceed the overall growth rate only on the cost of other areas. Technological advance (the size of s_2 is increased from the same s_1) may not help to overcome this limit on the long run as the percent of cost to raise children may stay the same in different types of societies when an equilibrium (transformation of variable cost into fix cost) has been reached again.

..... and what´s about the Nash equilibrium?

Equilibrium is the condition of a system in which competing influences are balanced and it may refer to mathematics, physics, chemistry, biology, economics and game theory.

The stationary point of a dynamical system is often called equilibrium. In game theory, a system is said to be in an equilibrium called the Nash equilibrium if there is no strategy which any of the components can improve their state in the system. If no one can improve how is advance and change possible?

To define a stable point is important to understand a system, but the dynamic of a system unfolds far away from equilibrium points. Life is a good example: Life is a condition far away from any chemical and thermodynamic equilibrium – so is economics. In Figure 3 I try to show how the Nash equilibrium and wise exploitation are related.

Figure 3

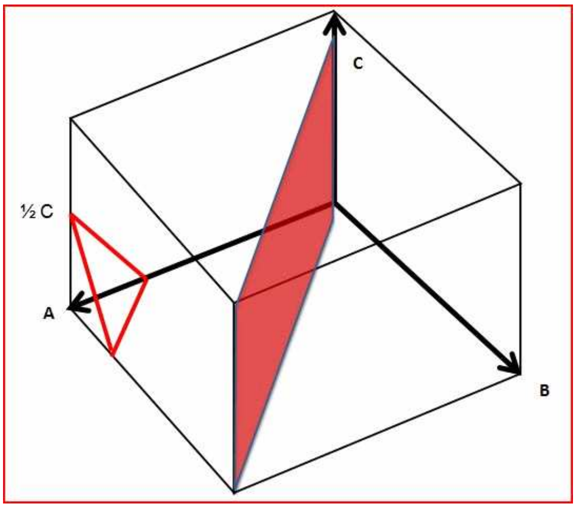

Figure 3. In this three dimensional transfer/exploitation space both parties (A and B) give and take (symmetrically). The axis is still the fix cost (C, here the same for both sides). The Nash equilibrium is the red plane. Wise exploitation is far away from the equilibrium in the lower corner of for example side A (see Figure 2). Here the productivity is generated to breed or educate in this case the exploited party B – a reward always included (s_2-s_1-br-e-2c>0).

A mutation is still able to invade wise exploitation however the world is full of islands and dramatic disasters. The higher productivity of the exploiting system will guarantee that disasters are survived by such populations and that empty islands will be colonized by such productive populations as long as the frequency of disasters is larger than the mutation towards taking all and migration. If the two sides are asymmetric equipped (ant and fungus) stability is only a question of the back mutation towards taking all of one side.

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