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The Transfer Space

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The Transfer Space

Abstract

The coordinates of the transfer space are loss of the source, gain of the sink and cost to both sides and compares the coupled gain and loss of two single parties to gain or loss of the ensemble of both, the invisible third party. Whenever two not identically equipped parties meet with the potential to exchange substrates one party will become a source and the other a sink. The outcome depends on the relation between fix cost, variable cost, productivity and affinity. The selfishly transferred substrate will optimize productivity of one or both sides and will lead under certain conditions to a productivity increase of the ensemble. This increase roots in the transfer of substrates from saturated to unsaturated production conditions. Brute force and educational conditioning take advantage of emotions to hide the real size of the cost to the exploited party. In case the transfer of substrates leads to increased productivity parts of the productivity might be reinvested to keep the exploited party. The lasting relationship is called wise exploitation. Wise exploitation may last for one or many generations depending on the use of brute force, education or breeding. To maintain a stable system the benefit must always exceed the cost. The transfer space views group (ensemble) selection as egoism based exploitation from catalytic networks to societies and interprets the decision process under external influence in a single economic entity.

Key words: source, sink, ensemble, group selection, selfishness, wise exploitation, brute force, fear, education, emotions, hope, hate, fix cost, variable cost, productivity, game theory, cooperation, prisoners´ dilemma, benefit, cost, transfer space, symbiosis, saturation function, predator, prey, stability, self sustaining, evolutionary stable, food chain, law of conservation of mass and energy, arms race

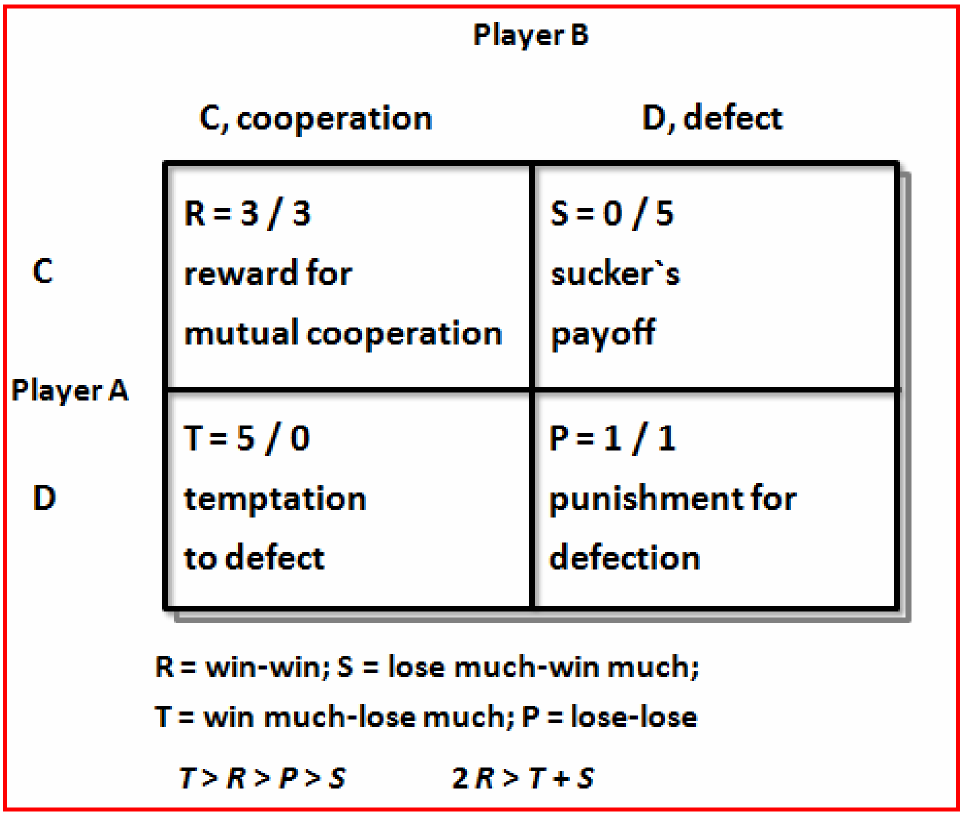
Introduction

Cooperation and prisoners´ dilemma

What is cooperation? Many definitions exist in the different fields of research. They all speak of joint interactions and working together of two parties for mutual benefits. But this kind of behaviour is hardly - if at all - observed. The reason is prisoners´ dilemma.

Axelrod and Hamilton (Axelrod, R. and Hamilton, W. D., 1981) use the following and generally accepted matrix to explain prisoners´ dilemma (Figure 1).

Figure 1



Player B

Player A	**C, cooperation**	**D, defect**
C	**R = 3 / 3** **reward for** **mutual cooperation**	**S = 0 / 5** **sucker`s** **payoff**
D	**T = 5 / 0** **temptation** **to defect**	**P = 1 / 1** **punishment for** **defection**

R = win-win; S = lose much-win much;
T = win much-lose much; P = lose-lose

$T > R > P > S \qquad 2R > T + S$

Figure 1. Prisoners´ dilemma, an example.

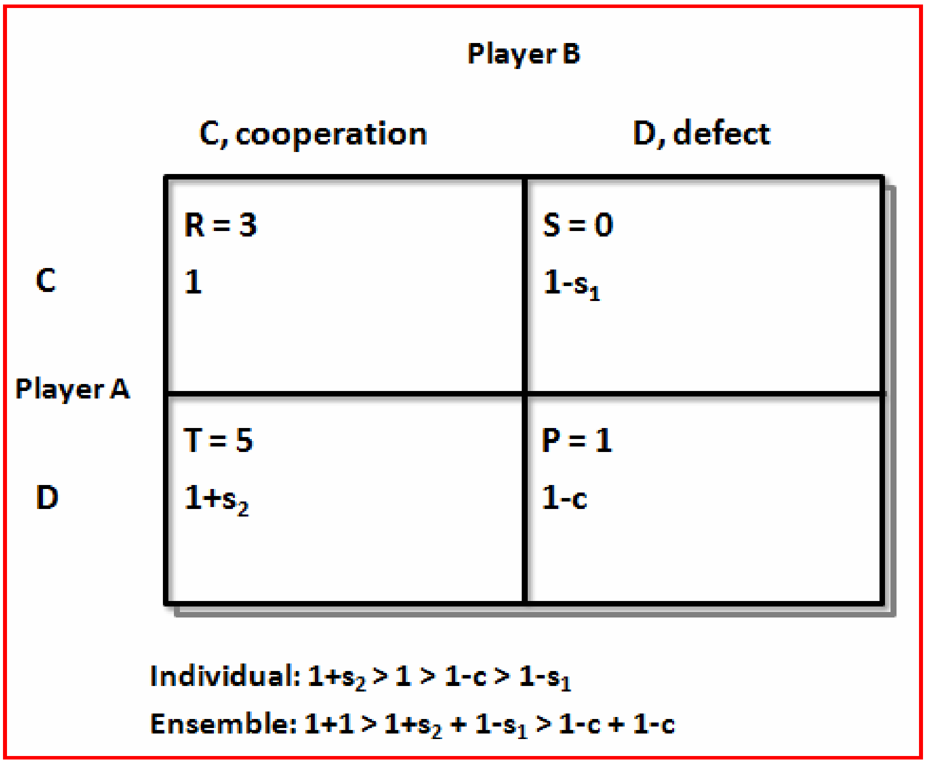
From arbitrary values they learn that successful exploitation (D) of a source may earn more for the sink than cooperation (D>C). The best productivity or fitness has the ensemble (Player A+B) if both parties cooperate (C+C>C+D>D+D). This is the prisoners´ dilemma – it would be better to cooperate, but the temptation to exploit someone or the danger of being exploited prevents cooperation (P>S though 2R>T+S>P+P). As defect is stable (D+D; a Nash equilibrium) it is puzzling to many authors why help between two organisms is observable. One reason is genetic relation – kin selection (Hamilton, W.D., 1964).

An unanswered question in this example is where does the productivity come from and why should the productivity in cooperation (C+C) be higher than in exploitation (C+D)? This view has evolved a little (Nowak, M. A., 2006). This author writes: “a cooperator is someone who pays a cost, c for another individual to receive a benefit, b. A defector has no cost and does not deal out benefits.” To assume that something (a benefit) can only come from something else (a cost) is a step forward. However such behaviour (giving) is difficult to understand. Giving is regarded as an altruistic action – it pays in terms of evolution only for offspring and other genetic relation. Complex evolutionary epicycles are invented to transfer the genetically founded behaviour altruism and kin selection to group selection with no genetic foundation (“A group of cooperators might be more successful than a group of defectors”, same author). The question is not answered where this additional fitness (productivity) has its source. The answer to this question is important as we live under the law of mass and energy conservation - one of the most important empirical laws and philosophic meaningful concepts.

As the values are arbitrary other outcomes are possible and would be worth to be discussed. A general form should be helpful. Turner and

Chao (Turner, P. E. and Chao. L., 1999) use an interesting general form to explain prisoners´ dilemma (Figure 2). They introduce a further simplification: one side gives and one side takes, a transfer is realized.

Figure 2



		Player B	
		C, cooperation	**D, defect**
Player A	**C**	**R = 3** **1**	**S = 0** $1-s_1$
	D	**T = 5** $1+s_2$	**P = 1** **1-c**

Individual: $1+s_2 > 1 > 1-c > 1-s_1$

Ensemble: $1+1 > 1+s_2 + 1-s_1 > 1-c + 1-c$

Figure 2. Prisoners´ dilemma, one side gives ($-s_1$) and one side takes ($+s_2$).

Using the same values as Axelrod and Hamilton we obtain the same result. Prisoners´ dilemma is P>S though 2R>T+S>P+P. In this new general form prisoners´ dilemma equals $1-s_1<1-c$. Cooperation (1=1) is doing better than exploitation ($1-s_1<1+s_2$). We could say: $1+1>1- s_1+1+s_2$.

The transfer space

What does the generalization (prisoners´ dilemma: $c<s_1$; cooperation is better than exploitation: $0>s_2-s_1 = s_2<s_1$) teach?

It seems there are three variables: s_1, s_2 and c and they are considered independent because the used values were arbitrary. Three independent variables may be best arranged in a three dimensional space, the transfer space (Figure 3). The size comparison of these variables may teach something like in prisoners´ dilemma (not giving, $c<s_1$). The pair wise combinations of three variables ($c<s_1$, $c>s_1$, $s_2<s_1$, $s_2>s_1$, $s_2>c$, $s_2<c$) form the surface of the transfer space.

Figure 3

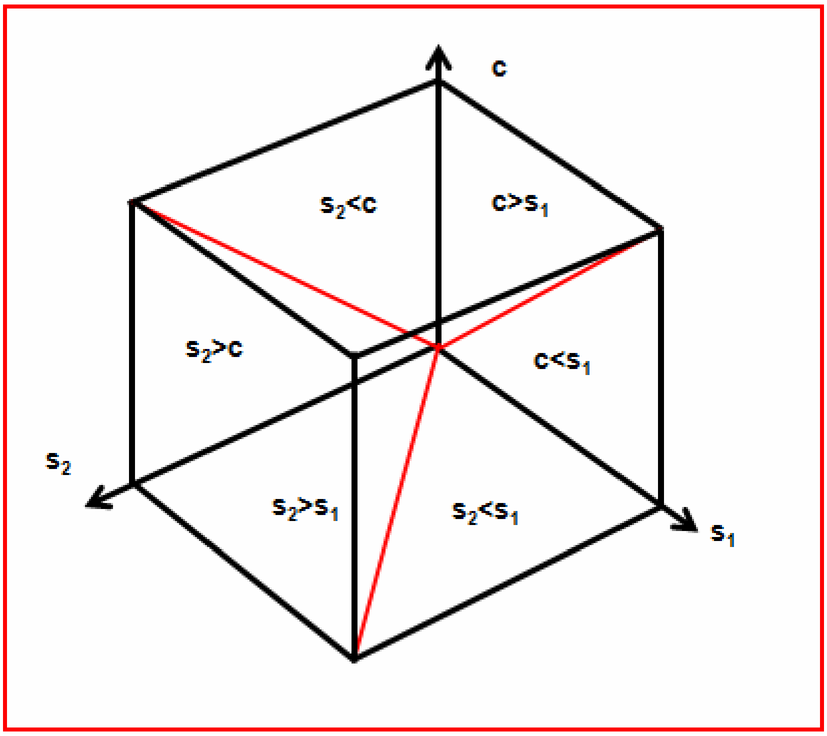


Figure 3. The transfer is space formed by the variables c, s_1 and s_2. The origin of the transfer space is where the red lines meet; $c=s_1=s_2=0$. The red lines are $s_2=s_1$, $c=s_1$ and $s_2=c$.

What do the variables mean?

- The variable c is the loss if a transfer does not take place. This variable seems to be some kind of fix cost – always present. It is a fix cost for both sides. This fix cost is not necessarily of the same size for player A and player B but will be connected by a factor or an equation.
- Although one substrate is transferred the loss to one party is not necessarily identical with the gain to the other party ($s_2>s_1$, $s_2<s_1$)! The transferred substrate will however couple s_1 and s_2.

- The variable s_1 contains the loss of one party (source). It consists of the fix cost (the essence of a fix cost is the ubiquity; c), the variable cost that is connected to the lost substrate (S) and the loss in productivity (p) with this lost substrate.
- The variable s_2 contains the gain of the other party (sink). It consists of the fix cost (c), the variable cost that is connected to the gained substrate (S) and the gain in productivity (p) with this substrate.
- Productivity (p) is a saturation function. At high saturation the gain in productivity is small compared to low saturation for the same amount of substrate (S). At high saturation the productivity with this substrate may be less earning than the variable cost for this substrate.
- Due to the general limitedness of resources biological and economic systems are usually not equally saturated – they are not Pareto efficient!
- The substrate (S) is a variable cost with a linear dependence.
- $s_1=c+S+p$ and $s_2=c+S+p$. This helps to understand why there is “giving”, “not giving”, “taking” and “not taking” without genetically founded altruism involved.

- giving: $c>s_1$ equals $c>c+S+p$ or $0>S+p$
- not giving: $c<s_1$ equals $c<c+S+p$ or $0<S+p$
- taking: $s_2>c$ equals $c+S+p>c$ or $S+p>0$
- not taking: $s_2<c$ equals $c+S+p<c$ or $S+p<0$

Not giving, $0<S+p$: The source would lose a highly productive (+p) substrate (S). As long as the source is uninfluenced and reasonable it will not give the valuable substrate.

Taking, S+p>0: The sink will take the substrate (S) because it will make a positive productivity (+p) contribution.

As S is always a positive value, p must be a large negative value (-p) in the case of “giving” (0>S+p) and “not taking” (S+p<0).

Giving, 0>S+p: A negative productivity loss is a relative productivity gain. Giving will increase the productivity! Giving will reduce variable cost that does not pay. Giving is a selfish act and will increase the productivity via reducing the amount of substrate not earning the variable cost at high saturation. This idea is important for two reasons. Giving is reasonable, selfish and economically founded. Giving is not a sacrifice. It is now independent of genetic relation.

Not taking, S+p<0: A negative productivity gain is a productivity loss. The second party will not take because a loss in productivity would be realized. Increasing the substrate (increase variable cost) at high saturation will decrease the relative productivity. This idea is important for two reasons. Not taking is not generous, it is reasonable. Not taking can prevent a decline of the productivity. It is independent now of genetic relation.

Giving, giving not, taking and taking not: These 4 types of behaviour meet in the three dimensional complex transfer space. The outcome of interactions depends on the physiological, emotional, informational and genetic condition of the parties.

- The saturating production functions in source and sink determine whether the transfer s_1 to s_2 will be productive ($s_2>s_1$) or consumptive

($s_2<s_1$). The effect is that the ensemble will be more or less productive than the sum of the single entities.

- The variables c, S and p will be of typical size for a species/population and vary slightly between individuals.
- The value of the fix cost is considered absolute indispensable by sink or source. The value of the variable cost depends on the contribution to the productivity (positive or negative).
- The indispensable fix cost (c) is connected to indispensable substrates and an indispensable productivity with these substrates. This productivity may or may not be saturated. But the degree of this saturation will determine the value of the lost or additional productivity with the variable cost (S) in source and sink.
- Source and sink are the projection of the transfer space on one side ($c-s_1$ and $c-s_2$). The outcome for the system (s_2-s_1) is a projection of the transfer space on the ground. The feature of the ensemble manifests within the transfer space and depends on source and sink.
- Giving and taking, brute force or informational influence on source and sink will change the perception of c, s_1 (c+S+p) and s_2 (c+S+p). This can be interpreted either as a deformation of the transfer space or a movement of source and sink along the sides of the transfer space.
- Now we can give names to the different situations:

$c<s_1$: prisoners´ dilemma; avoided exploitation, giving will decrease source productivity

$c>s_1$: tolerated exploitation, giving improves source productivity

$s_2<s_1$: consumptive exploitation, the ensemble looses productivity

$s_2>s_1$: productive exploitation, the ensemble gains productivity

$s_2>c$: cost efficient exploitation, taking will increase sink productivity

$s_2<c$: costing exploitation, taking will decrease sink productivity

1-1=0: cooperation, the starting point $c=s_1=s_2=0$

Discussion

I suggest a new perspective to look at two parties capable to exchange substrates. This idea explains exchange related behaviour on different levels of complexity like enzymes, cells (many enzymes), organisms (many cells) and societies (many organisms) and suggests a source of productivity to fuel group selection without gene or moral founded altruism. Here a purely selfish founded explanation is introduced. The ensemble within the space is a complex entity. Therefore, it is better to look at first at the surface of the transfer space and its origin.

- Cooperation, the entry point into the transfer space:

Now cooperation formally is the entry point into the transfer space. In cooperation nothing is transferred ($s_1=s_2=0$) at no cost ($c=0$) but the two parties are able to exchange. What is usually implied using the word cooperation is a point of the coordinates $s_2>>s_1$, $s_1≈0$, $c≈0$. In this point productivity is generated from a small loss (transfer) at negligible cost and part of the gain is shared. This will be explained later and is called wise exploitation.

- Productive and consumptive exploitation; the surface s_2-s_1:

Giving and taking create or destroy productivity within the ensemble. The productivity gain $s_2>s_1$ is the intrinsic power source for the ensemble and is called productive exploitation. The transfer of one substrate from a saturated condition to an unsaturated condition is the reason for the increase in productivity (Figure 4). The increased productivity is realized in the sink. The sink controls the gain and this is the maximal reward. The ensemble of sink and source together has a better productivity then the sum of both parties alone. This is an advantage to the group but on cost of the source. The productivity of the source will decrease and finally the source will be lost. The advantage to the sink and the group is gone. The sink will need new exploitable source from anywhere else.

The transfer from an unsaturated condition to a saturated condition will lead to a decrease in ensemble productivity ($s_2<s_1$) and is called consumptive exploitation (Figure 4). The smaller productivity is realized and controlled by the sink. A reward is still obtained but the catch to the sink is smaller than the loss to the source. But it is still an advantage to the sink. The ensemble of sink and source together has a smaller productivity than the sum of both parties alone. This is a disadvantage to the group and in addition on cost of the source. The productivity of the source and the group will decrease very fast and finally the source will be lost. The sink will need new exploitable source from anywhere else.

Figure 4

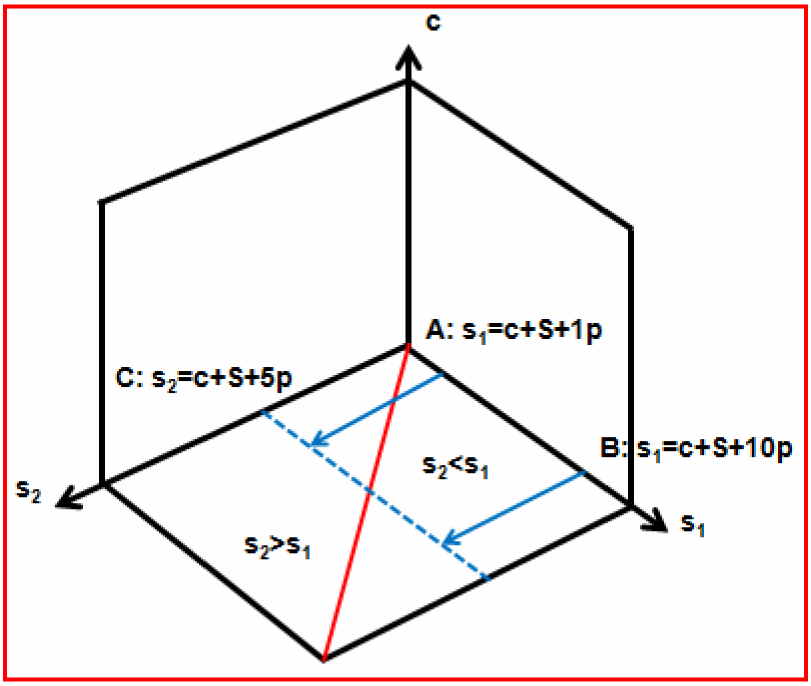


Figure 4. An example: In case A a source has a fix cost (c) and a variable substrate cost (S) and a certain productivity (1p) with this amount of substrate. In a second case (B) a different source has the same fix (c) and variable cost (S) as A, but at a tenfold productivity (10p) with this amount of substrate. The same amount of substrate (S) in both cases is transferred to the same sink. With the same amount of substrate the sink may have a productivity of 5p at identical fix and variable cost. The

ensemble AC will have a fivefold increased productivity. The productivity of the ensemble BC however is cut by half. AC is a productive transfer ($s_2>s_1$), BC is a consumptive transfer ($s_2<s_1$).

- Brute force, the surface c-s_1:

In prisoners´ dilemma nothing is transferred because not giving is cheaper ($c<s_1$). Only the anyway spent fix cost (c) but no additional highly productive substrate is lost. Brute force (bf) will increase the cost of "not giving". To withstand the force the amount of indispensable cost (c) must be increased. The size relation will therefore change. Starting at $c<s_1$ the increase will finally exceed $c=s_1$ ($c+bf>s_1$) now variable cost is given to optimize own productivity. Both sides may be hurt seriously as bf is a risky investment. But once bf is effective cheap threatening will make the subdominant party give. Threatening evokes an emotion called fear (f). Fear will hide the true cost of giving (s_1) (Figure 5).

Figure 5

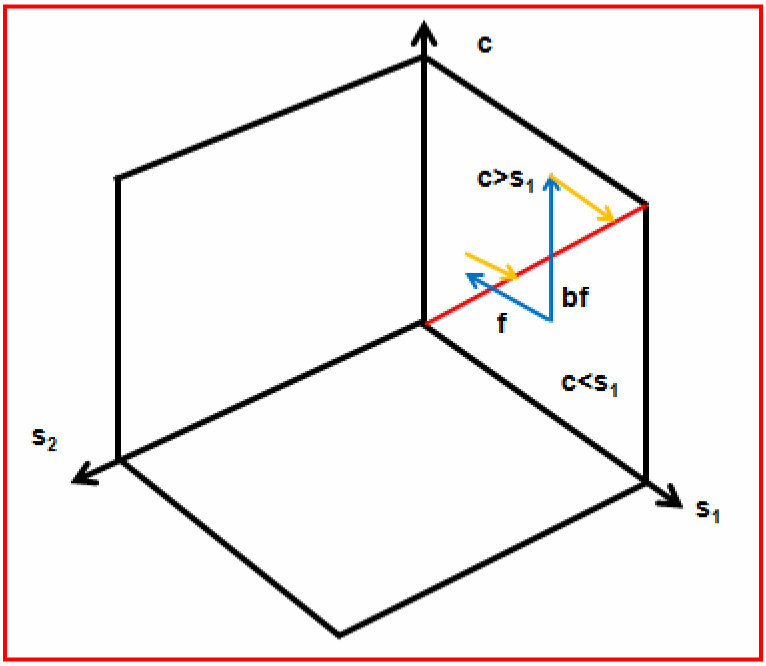


Figure 5. At first brute force (bf, blue arrow) will increase the fix cost (c) for the subdominant party. Giving (orange arrow) is induced as variable cost no longer pay at that relationship between fix cost, variable cost and productivity. Later fear is sufficient. Fear (blue arrow, f) hides the true cost s_1 and induces giving (orange arrow) at lower fix cost. The red line separates $c>s_1$ and $c<s_1$.

The intensity of brute force and fear correlate directly to the amount given ($bf=S+p$). The productivity with the present variable cost and fix cost does not pay the defence. Costing variable cost is given to increase productivity. Even a new assessment of the fix cost may take place and a part of the fix cost is transformed to a variable cost and given, too.

- Education, the surface $c-s_1$:

Education is used in intelligent species. It is difficult to determine the true degree of saturation in a complex organism. Manifold, different and complex internal and external information has to be processed. This processing can be manipulated through appropriate additional information. Education is an investment by one party to influence the behaviour of a second party. Education as external information is capable to change the perception of the relation between fix cost (c), variable cost (S) and productivity (p). The size relation will change from $c<s_1$ to $c+e>s_1$. It appears to the source as if the amount of fix cost and degree of saturation has increased. This changes the behaviour of the source from “not giving” to “giving”.

Emotions (hope, h) hide the true size of the loss (s_1). The role of emotions in cooperation related behaviour has been addressed (Fessler and Haley, 2002). An alternative interpretation is that the whole space is deformed and the source differently judges the own position and the border between $c<s_1$ and $c>s_1$ and will give (Figure 6a). Giving will stop at $c=s_1$. The size of the difference (c minus s_1) determines how intensive education and hope have to be. Positive emotions conditioned through education and induced by the sink will trigger the interpretation that fix cost is high and productivity is saturated. Variable cost is costing and therefore given. Even the fix cost could be reassessed and parts transformed into variable cost and given to the sink. The given variable cost is characterized by $e=S+p$. An objective loss is happily realized!

Figure 6a

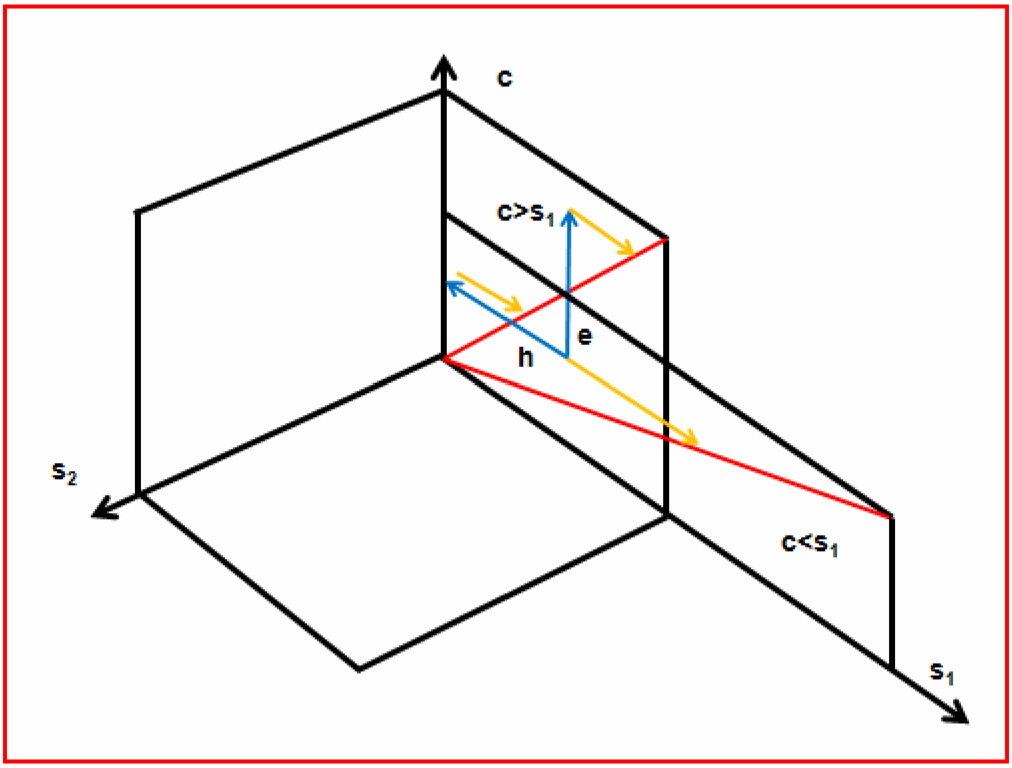


Figure 6a. Education (blue arrow, e) manipulates the perception of the fix cost and giving (orange arrow) is induced. Hope (blue arrow, h, educational conditioning of endogenous reward systems) is induced and hides the true cost (s_1) and giving is induced (short orange arrow). Education can also change the perception of the whole transfer space and induce giving (long orange arrow) directly. The red lines separate $c>s_1$ and $c<s_1$.

Negative emotions:

Hate is an example for negative emotions. Hate may involve two or three parties, one or two competing ensembles.

Two parties: The action (e) of a sink may induce hate of a source. The source is moved from giving ($c>s_1$) to not giving ($c-e<s_1$) (Figure 6b). It appears to the source as if a part of the indispensable fix cost has been lost. This must be replaced by variable cost. The residual variable cost seems to be much more productive and has now an increased value. A highly productive substrate is not given away. The emotion hate makes

the source evaluate the relationship between c, S and p differently. Also the transfer space could be deformed. Hate makes the source overestimate the size of the loss s_1.

Three parties: Hate is educational (through information; either true or false) induced by a third party in a source to avoid giving to a sink so that there will be more residual reserves for the third party or that the productive interaction between source and sink is disrupted. Less productivity will be an advantage to the competing ensemble the third party is a part of.

Figure 6b

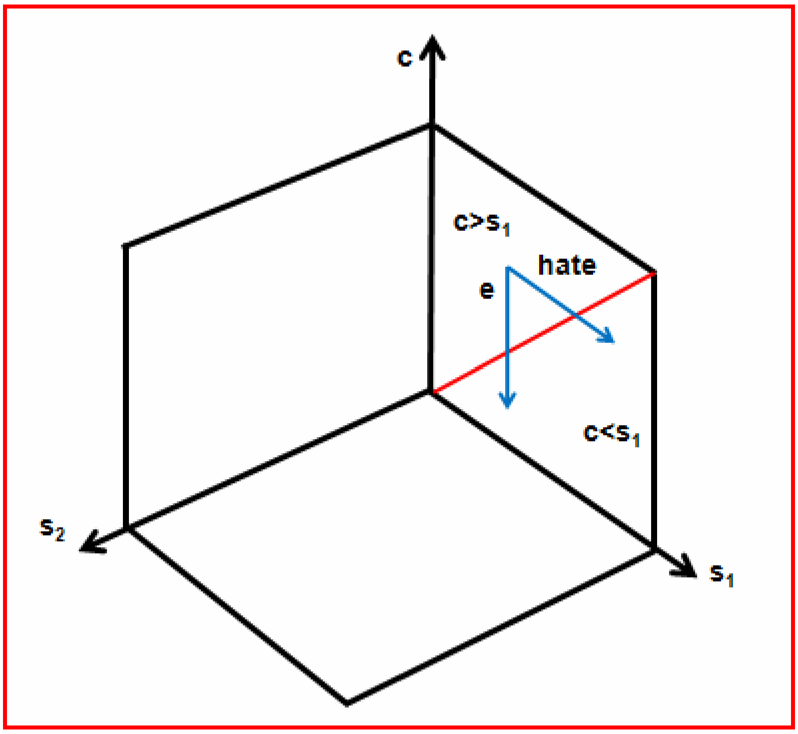


Figure 6b. Education (blue arrow, e) manipulates the perception of the fix cost (amount or saturation) and giving ends. Hate makes the source overestimate the size of the loss s_1. An interpretation is an increased value of the variable cost because lost fix cost had to be replaced with parts of the variable cost increasing the value of the residual variable cost. Or: Lost fix cost decreases saturation and increases productivity and value of the variable cost. The intensity of hate is direct proportional to the resulting size of the difference c minus s_1. The red line separates $c>s_1$ and $c<s_1$.

- Brute force, the surface c-s_2:

In cost efficient exploitation ($s_2>c$) taking is cheap and effective for the dominant party (sink) but the subdominant party (source) may not be willing to give because the status there is not saturated anymore. Brute (counter) force will increase the cost of taking. The size relation will therefore change from $s_2>c$ to $s_2\leq c+bf$. Now the dominant party will no longer take because the border to costing exploitation is exceeded. Also here bf is a risky investment. Both sides may be hurt seriously. But once bf is effective cheap threatening will make the dominant party recoil from taking. Threatening evokes an emotion called fear to hide the true gain of taking (s_2) (Figure 7).

Figure 7

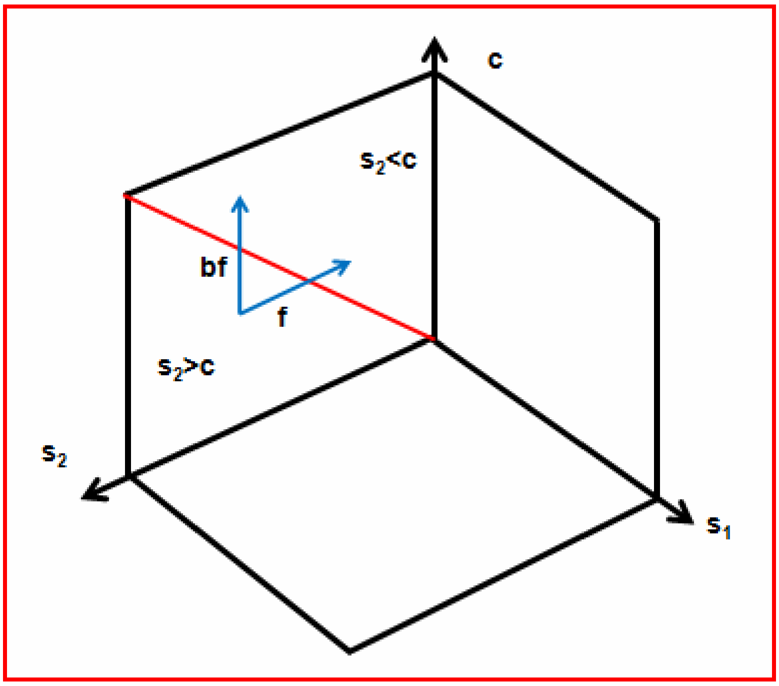


Figure 7. At first brute force (bf, blue arrow) will increase the fix cost (c) for the dominant party. Not taking is induced at that relationship between cost and productivity (costing exploitation). Later fear (f, blue arrow) is sufficient. Fear hides the true gain s_2. The red line separates $s_2>c$ and $s_2<c$. In the described case giving back could be a result as the border $s_2=c$ is exceeded. A sink is turned into a source.

A fight could be interpreted as a test which party is nearer to the border of giving/not giving – taking/not taking. Or: Who is more and who is less saturated? The minimal intensity of the counterforce is determined by the distance to the border s_2=c. But it should be clear that in every production function the most left point is zero. At high saturation there may be low productivity but there is also endurance. s_1 or s_2=c+S+p could also be interpreted as a space with many different positions.

- Education, the surface c-s_2:

Usually the exploiting party (sink) will educate the exploited party (source) to tolerate exploitation in hope (h) for a better ending. This may lead to exhaustion of the exploited party and a decrease of productivity of the whole ensemble. Ensembles with low productivity will be defeated by ensembles with high productivity. The highest productivity will be reached at optimal distribution of material and energy (substrates) between both parties so that both are combined maximal productive. Therefore, it could be in the interest of the exploiting party to restrain from complete exploitation of the exploited party. The birth of moral.

Education as investment could originate in the dominant party but also within the subdominant party to change the behaviour of the dominant party. The size relation will change from s_2>c to s_2<c+e. The dominant party is changed from “taking” to “not taking”. The perception of size and saturation within the fix cost (c) is changed by education (e). Emotions (hope, h) hide here the size of s_2, the possible gain and reward. A different idea is that the transfer space is deformed and the addressed party judges the position of the border between s_2>c and s_2<c differently and will not take (Figure 8a). Not taking will start at c=s_2. The size of the difference (s_2 minus c) determines how intensive education and hope (emotions) have to be to avoid taking.

Positive emotions conditioned through education and induced by source or sink will make the sink differently interpret the degree of saturation in the fix cost. Variable cost is no longer taken from the source because this would decrease sink productivity due to erroneously assumed high saturation in the sink. In addition, the value of the fix cost could be reassessed and partially transformed into a variable cost and given. A loss of profit is proudly realized.

Figure 8a

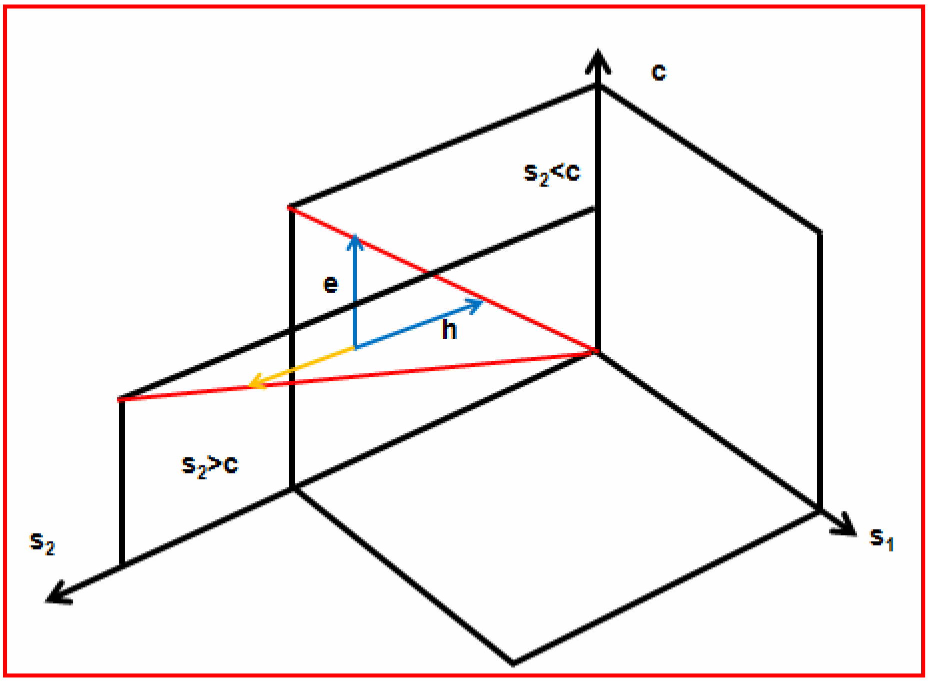


Figure 8a. Education (e, blue arrow) manipulates the perception of the fix cost. Hope (h, emotions, blue arrow; an educational conditioning of the endogenous reward system) is induced and hides the true gain. Education can also change the whole judgment of the transfer space and the perception of the own position within that space (from $s_2>c$ to $s_2<c$). In this case giving back (orange arrow) would be induced in the sink. The sink becomes a source. This change of perception may also be a natural result of aging and increased saturation beyond the period of growth.

Negative emotions:

Hate is a negative emotion. Again hate may involve two or three parties, one or two competing ensembles.

Two parties: The action (e) of a source may induce hate of a sink. The sink is moved from not taking ($s_2<c$) to taking ($s_2>c-e$) (Figure 8b). Now it appears to the sink as if parts of the fix cost have been taken away. The indispensable fix cost must be replaced with variable cost. New variable cost will increase productivity. This new variable cost is taken from the source in hate. Alternatively the transfer space could be deformed.

Three parties: Hate is educational induced in the sink by a third party to induce taking from a source to harm the source. This may have the effect that the source is overstressed and the productivity of the ensemble will decrease in a competitive situation between two ensembles.

Figure 8b

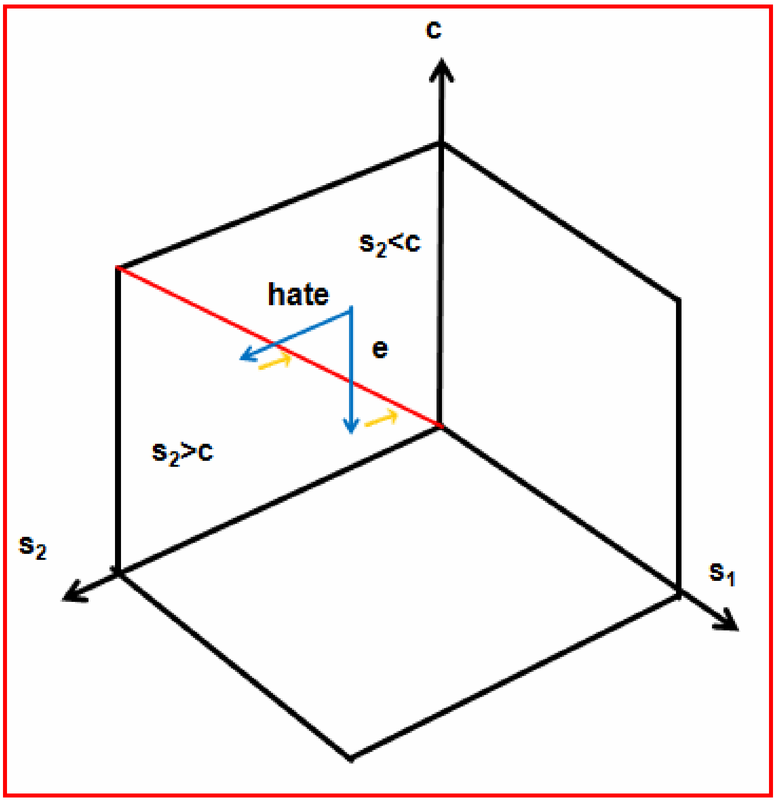


Figure 8b. Taking away or education (e, blue arrow) to hate manipulates the perception of the fix cost in the sink. Hate (blue arrow) is induced and overrates the true gain. Taking is induced (orange arrows). The red line separates $s_2>c$ and $s_2<c$.

- Harmful exploitation; the surface s_2-s_1 and the effect of brute force, education and breeding.

As long as the source is in $c>s_1$ the source will selfishly give to increase own productivity – in case a sink will take. This is an advantage through increased productivity to all sides: source, sink and the ensemble. No party is harmed or suffers.

If taking by the sink is larger than the additional productivity through giving the source will approach $c=s_1$. As soon as the source arrives at $c=s_1$ further taking would decrease productivity of the source and therefore giving by the source will selfish end. The exploited party is at first lost to prisoners´ dilemma. A source also may be right from the very beginning of the contact in prisoners´ dilemma. If the sink wants to take in prisoners´ dilemma two possibilities exist.

Exploitation with brute force, (s_2-s_1-bf>0) or (s_2-s_1-bf<0):
Brute force (bf) is an investment of the exploiting party (sink) to induce giving by the source in prisoners´ dilemma. Fear (f) hides the true size of s_1 but is imaginary (exists only in c-s_1; c-s_2) and is not added (Figure 9).
Exploitation with education, (s_2-s_1-e>0) or (s_2-s_1-e<0):
Education (e) is an investment of the exploiting party (sink) to induce giving by the source in prisoners´ dilemma. Hope (h, conditioned positive emotions. The reward exists only in the brain. c-s_1; c-s_2) is virtual and therefore not added (Figure 9). Hope hides the true size of s_1.

Figure 9

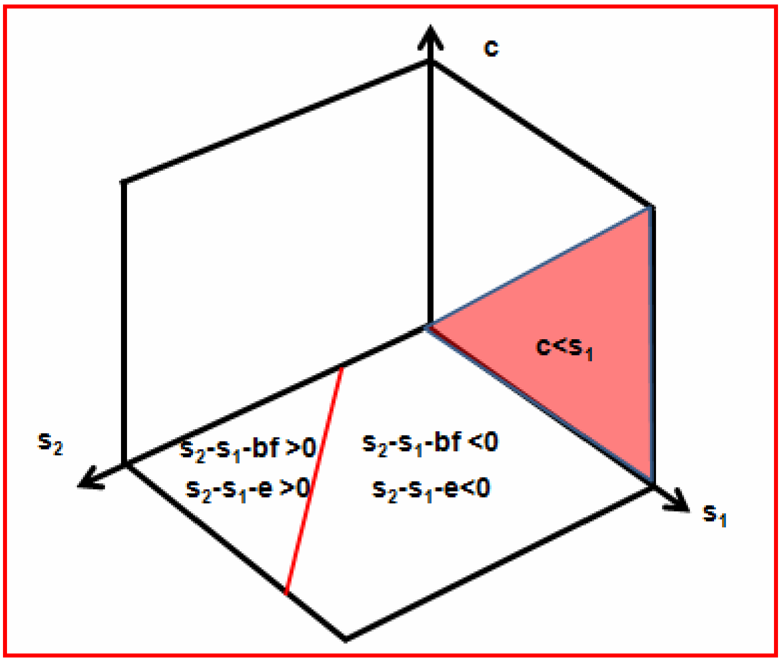


Figure 9. The investments brute force (bf) and education (e) always contain a reward for the exploiting party. The red line separates now the area where the investment (bf, e) is overcompensated (>0, wise) and where the investment (bf, e) is not overcompensated (<0) by the gain through the transfer. The red triangle ($c<s_1$) is prisoners´ dilemma (not giving) but giving is induced through brute force and educational conditioning. In the region s_2-s_1-bf<0 or s_2-s_1-e<0 quantity may be traded for quality even though the investment is not paid.

The use of brute force and education changes the behaviour of the exploited party in prisoners´ dilemma from not giving to giving. But this behaviour is harmful and not reasonable. The productivity of the source will further decrease and then the source will be lost completely (physically) through extinction or consumption.

In rare cases the source may be saturated and wants to give to optimize own productivity but the saturated sink does not want to take. Brute force or education (e.g. subvention, corruption) may also be used here to make the sink take although this is not reasonable. This will be harmful to the productivity of the sink and the ensemble.

Why can it be evolutionary stable to take in prisoners´ dilemma?

How can the loss of the exploited party be avoided?

- Productive wise exploitation with brute force (s_2-s_1-bf>0):

Brute force between different species:

The transfer of the substrate between two different species may lead to a higher productivity of the ensemble so that the investment (bf) is overcompensated. This leads to productive wise exploitation with brute force and fear (s_2-s_1-bf>0). Wise refers to the fact that the gain will pay the investment including a reward. Brute force in enzymes is a higher affinity. In primitive organisms fear will be absent. The ensemble with such behaviour will succeed against other not so productive ensembles of different species or single competing species. However, the source will suffer a decrease in fitness and therefore vanish. The ensemble may succeed against a competing party on the short run but it will only survive on the long run if parts of the gain are also used to breed the source. An example would be the leafcutter ant with the fungus grown in their garden. Parts of the living fungus are eaten (bf) but also bred (br). Leafcutter ants form the largest colonies of all ants. Grazing and hunting use brute force to exploit the source but usually no breeding of the source is observed. This leads only to predator-prey type stability (Lotka, A.J. 1920, Volterra, V. 1926, Prigogine, I. 1977). If the transfer is consumptive (s_2-s_1-bf<0) the dominant party needs continuous influx of exploitable individuals also but the ensemble-productivity is far below the sum of the single parties. The small reward to the sink may be enough to push through against a single competitor without an additional resource.

Brute force within the same species:

Naturally emerging asymmetries (male/female; young/old, strong/weak) may serve the same purpose as breeding. With every new generation the consumed sources are replaced resulting in a higher productivity of the ensemble of e.g. strong and weak. The increased productivity (s_2-s_1-bf>0) comes from the species internal transfer. This could be called self-exploitation. Every species produces surplus offspring. This surplus is partly consumed by disasters, diseases, predators and starvation. In self exploitation part of the surplus is transformed into e.g. more muscles or larger fat reserves or more offspring of the dominant animal. This may lead to a better survival or better competitiveness of the whole group against other groups but on cost of the source.

- Productive wise exploitation with education (s_2-s_1-e>0):

The transfer of the substrate to the exploiting party (sink) may lead to a higher productivity of the ensemble so that the investment education (e) is overcompensated. This leads to productive wise exploitation with education to hope (s_2-s_1-e>0). In this case the ensemble with such a behaviour will succeed against other not so productive ensembles or single parties. However, the educated party will suffer a decrease in fitness in $c<s_1$ (prisoners´ dilemma). The ensemble may succeed against competitors on the short run but it will only survive on the long run if parts of the gain are also used to stabilize the exploited party. If the transfer is consumptive (s_2-s_1-e<0) the dominant party needs continuous influx of exploitable individuals also. This behaviour is not self sustainable and will only continue as long as no better competitors arise and the influx is constant. The long term physical loss of the exploited party in prisoners´ dilemma using brute force or education can be only counteracted through breeding.

- Productive wise exploitation with breeding (s_2-s_1-br>0):

All animals and man depend on an energy and substrate source. If the source is consumed completely the sink can no longer survive. Taking from a source will decrease the productivity of the source and finally consume the source. The source must be replaced if the sink will use the source further. Two possibilities exist.

First: New sources must be found. This will only be the case when the source is produced somewhere else unhindered and unconsumed and a surplus leaks to the place where it will be consumed. Or the energy reserves are big enough to carry the sink there. This situation reminds of a predator-prey relationship in biology. This is the case (consumptive or productive exploitation) as long as breeding is absent.

Second: The sink uses parts of the gain to replace the consumed source through breeding. Though the source is consumed, new source will replace the loss. This is called wise exploitation with breeding: s_2-s_1-

$br>0$, the essence of farming. The productivity gain ($s_2-s_1>0$, productive exploitation) is so big that besides a reward a reinvestment (br) into the stability of the source can be made. Due to the reinvestment breeding is not as much earning as complete exploitation but will last longer.

- Several forms of productive wise exploitation, a comparison:

When $s_2>>s_1$ there will be so much productivity generated that besides a reward for the exploiting party parts of the gain may be reinvested to stabilize the source. This is called productive wise exploitation (a special case of productive exploitation, Figure 10). Due to the reinvestment (productive) wise exploitation is earning less than productive exploitation in the same spot but it will last longer. The productivity gain to the system is no miraculous violation of mass and energy conservation. The gain is a result of the transfer of a substrate from a flat part of a production function (saturated, source) to the steep part of another production function (not saturated, sink).

Figure 10

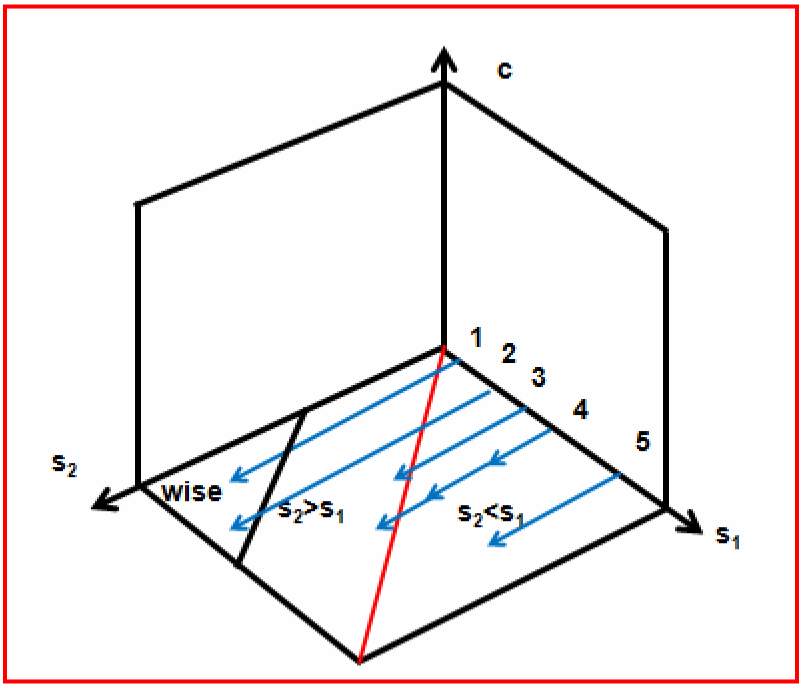


Figure 10. At small fix and variable cost and high productivity (low saturation) in the sink and low productivity (high saturation) in the source the region of wise exploitation is in reach (blue arrow, 1). This region is also in reach by inventions to increase the leverage (2). At higher cost or higher productivity in the source or lower productivity in the sink only the region of productive exploitation (3) can be reached. But a reward will always be gained and the ensemble is more productive than the single parties. The size of the reward and the size of the necessary investment determine when wise exploitation will be reached. Productive exploitation is also in reach adding several smaller contributions from several sources (4). Finally at very high cost (or low cost and high productivity; s_1=c+S+p) only consumptive exploitation is reached. A reward is still earned but here the productivity of the ensemble is below the productivity of both parties. In example 3, 4 and 5 the source must come from anywhere else to maintain the system. The red line separates $s_2>s_1$ from $s_2<s_1$.

Breeding, brute force and education are different forms of wise exploitation. Breeding (s_2-s_1-br>0) is a long lasting investment of the exploiting party into the exploited party. This is driven by the gain from the transfer of the substrate to a better production function. Breeding will last many generations although wise exploitation is less earning than productive exploitation in the same spot. Pure productive exploitation will consume the source push trough against direct competitors and disappear when there is no source anymore. If both strategies are not in permanent contact and only in indirect competition reinvesting strategies win. In intelligent species exploitation will be detected very fast. Here - on the short run within one lifetime - brute force and education prevent the loss of the exploited party, too. The loss here is to be understood as entering prisoners´ dilemma (not giving). As long as the source exists it can be exploited repeatedly in hope and fear. This will harm the source and lead to suffering (decreased own productivity). This middle term strategy of exploitation may be also part of pure productive or consumptive exploitation.

As long as there is influx of exploitable entities or self sustaining breeding, harmful exploitation starting in prisoners´ dilemma is evolutionary stable.

- Productive wise exploitation within the complete transfer space:

The three variables s_1, s_2 and c shape the transfer space. They are coupled. Within this space we observe self-organization. If $c>s_1$ giving will be no problem as giving will improve the productivity of the source. To give in avoided exploitation (prisoners´ dilemma, $c<s_1$) would decrease the productivity of the source and is therefore not reasonable and will lead to exhaustion if induced by brute force or education. On the other side taking will only be observed if $s_2>c$ (cost efficient exploitation). Costing exploitation ($s_2<c$) would lead to a decrease in productivity of the sink. Additional consequences are to be discussed:

1. Taking not ($s_2<c$) and giving deliberately ($c>s_1$) are observed with high fix cost and high saturation. Conflicts on the basis of this problem will be rare. If the source will use force or education to make the sink take we observe wise exploitation type II. The productivity of the sink suffers but the ensemble has an increased productivity (11.1) through the much stronger increase of productivity in the source. The sink will vanish due to the forced unreasonable behaviour. In case the productivity in the sink (11.1) would be a little bit better, the region of taking ($s_2>c$) would be reached by the blue arrow 1.
2. Once giving deliberately ($c>s_1$) and taking ($s_2>c$) are combined the productivity of source, sink and the ensemble will increase very much (11,2). But taking will not end if saturation ($s_2<c$) is not reached for the sink. The source will cross the border ($c=s_1$) first at low fix cost and then move on to prisoners´ dilemma ($c<s_1$) (Figure 11,3).
3. Taking from prisoners´ dilemma (giving not, $c<s_1$, Figure 11,3) is only possible using brute force and education (wise exploitation

type I). The productivity of the ensemble will end when the source is consumed without breeding. But until then the ensemble is more productive.

4. The zone s_2-s_1>>0 (s_2-s_1-br>0 or s_2-s_1-br-bf-e>0) is producing the surplus and long term stability to fuel co-evolution (Figure 11).

Figure 11

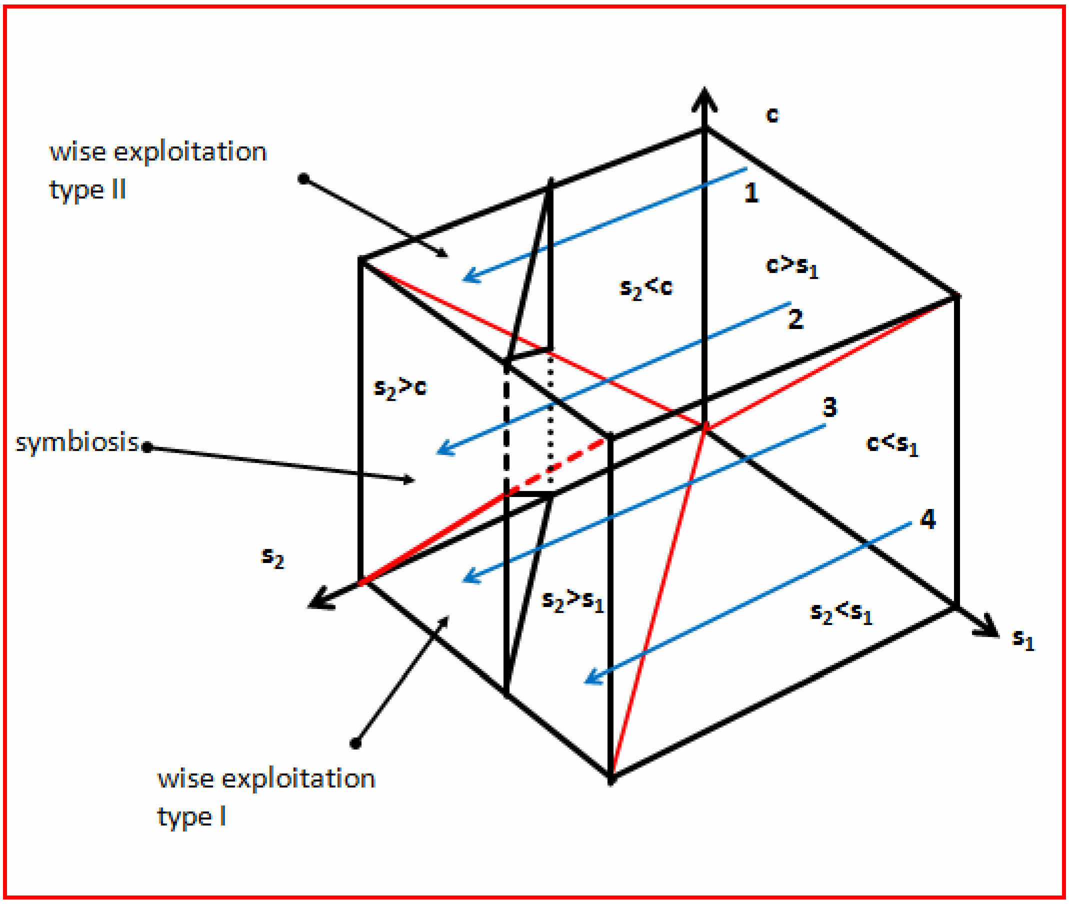


Figure 11. In this example the transfer s_1 to s_2 is very effective (highly productive in s_2), the blue arrows are very long. High fix cost and saturation will lead to the behaviour of giving deliberately and taking not (arrow 1). Wise exploitation type II may take over here. Giving in saturation and taking follow then (arrow 2). At small fix and variable cost wise exploitation type I is in reach (arrow 3: s_2-s_1-br-bf>0, s_2-s_1-br-e>0). Giving will be deliberately in 1 and 2 and not harming only in 2. Education and brute force have to be used to induce taking in 1 and giving in 3 and 4. At higher cost or higher productivity in the source only the region of productive exploitation (arrow 4: s_2-s_1>0) will be in reach. The investment (bf, e) is no longer paid if it is still used (s_2-s_1-br-bf<0, s_2-s_1-br-e<0) but quantity may be traded for quality. An example for consumptive exploitation is not shown.

5. There are two tetrahedral spaces (wise exploitation type I and II). They are either under control of the source (II) or the sink (I). The volume in between is indifferent (dotted lines). The ensemble may exist there as long as production and consumption are in a balance (steady state). This indifferent situation could be stabilized if the source would have the control. Then we observe “true symbiosis”. In true symbiosis the source can stop giving at $c=s_1$ and the sink is no longer able to take. The sink on the other side will stop taking at $s_2=c$ (Figure 11, arrow 2). Wise exploitation type I is under the control of the sink, true symbiosis and wise exploitation type II is under control of the source.
6. Wise exploitation type I: The limits of the subspace of wise exploitation type I with brute force are: $s_2-s_1-bf>0$ and $c<s_1$. Therefore, if $s_2-bf-c>0$ we are in the subspace of wise exploitation of the source. Wise exploitation type I is observed when source and sink are both not saturated (the sink will take, the source will not give). Due to the limitedness of resources in economy and biology this will be a standard situation.

   Wise exploitation type II: The limits of the subspace of wise exploitation type II with brute force are: $s_2-s_1-bf>0$ and $s_2<c$. If we observe $c-s_1-bf>0$ we observe wise exploitation of the sink. A rare event as saturation in source and sink is a prerequisite.

   In other cases bf may be replaced with education e or breeding br and all together.
7. Matrix and vector calculations would be an appropriate treatment (Figure 12) to understand the complete ensemble. The vector represents a single feature – a single interaction of an ensemble of two parties.

Figure 12

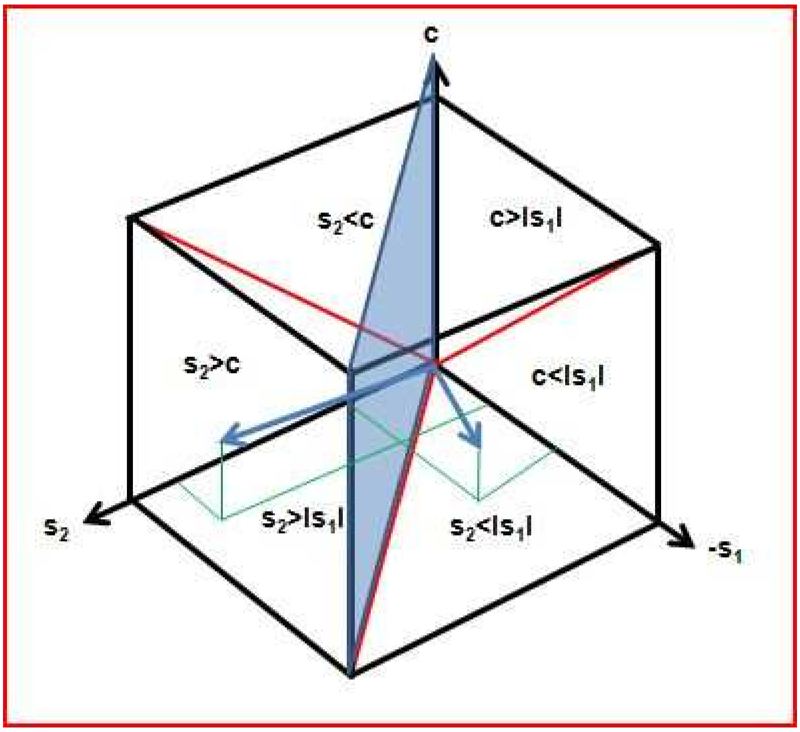


Figure 12. In this graphical interpretation “giving” ($-s_1$), “taking” ($+s_2$) and fix cost (c) are the coordinates. Two vectors begin at the origin and point either onto the negative side of the transfer space (right side of the blue surface, consumptive exploitation, $s_2<Is_1I$) or the positive portion of the transfer space (left side of the blue surface, productive exploitation, $s_2>Is_1I$). The endpoint of the vector is determined by the size of s_2, s_1 and c (green lines). Superposition of all transfer spaces of all sources and sinks related to such single features forms the complete ensemble; a complex entity. This entity is easily recognizable as a body build by many cells but difficult to understand as a group formed by many individuals.

- The decision process within a single economic entity:

Individual economic activity is based on a double transfer, an exchange. For example money is exchanged for a good or a service. The central question to the subject is always: Does it pay? The judgment is not easy and secure as different objects on different baselines are to be compared and the value depends on time, changing emotions, additional information and many other factors. The productivity within the transfer space is not easy determined. Figure 13 compares different situations. To make it less difficult all fix cost c is of the same size and c is identical between source and sink.

Figure 13

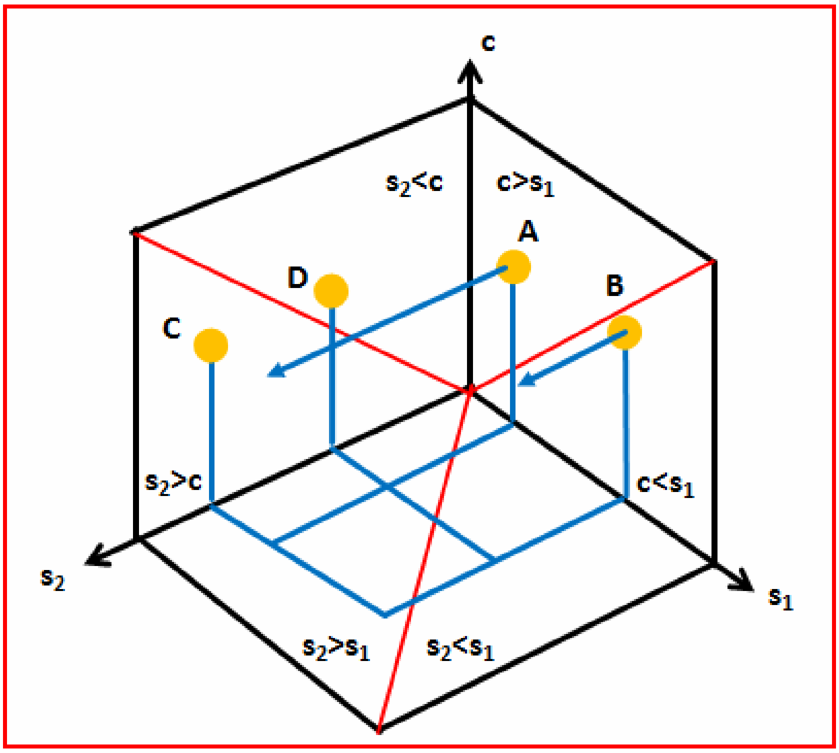


Figure 13. In this picture an economic subject gives (e.g. money – the same amount but at different productivity, A and B) to take a good or service of different values (C, D). The best exchange is AC. This is obvious as A as well as C are in the region "giving" and "taking". But also the exchanges AD and BC seem to be productive (earning) although this is not obvious as D "not taking" and B "not giving" usually are to be avoided. BD is a consumptive (loosing) exchange. The easy observation of one or two sides of the transfer space is not sufficient.

The exchange AC seems to be a reasonable exchange. The exchange BD will for sure not be realized in a reasonable subject. But external influence is able to deform the transfer space in a way that economic harm and unreasonable behaviour is the result, a consumptive transfer (Figure 14). It may appear that the surface s_2-s_1 is an objective criterion to judge the real value of the exchange to the observed subject or the observed parties. However this plane will also be deformed through information and emotion and in addition, this surface does not consider the cost (the already achieved saturation, the potential additional productivity with the variable cost) as c is zero. Moving e.g. D along the c-axis will not change the result in s_2-s_1 (Figure 14).

Figure 14

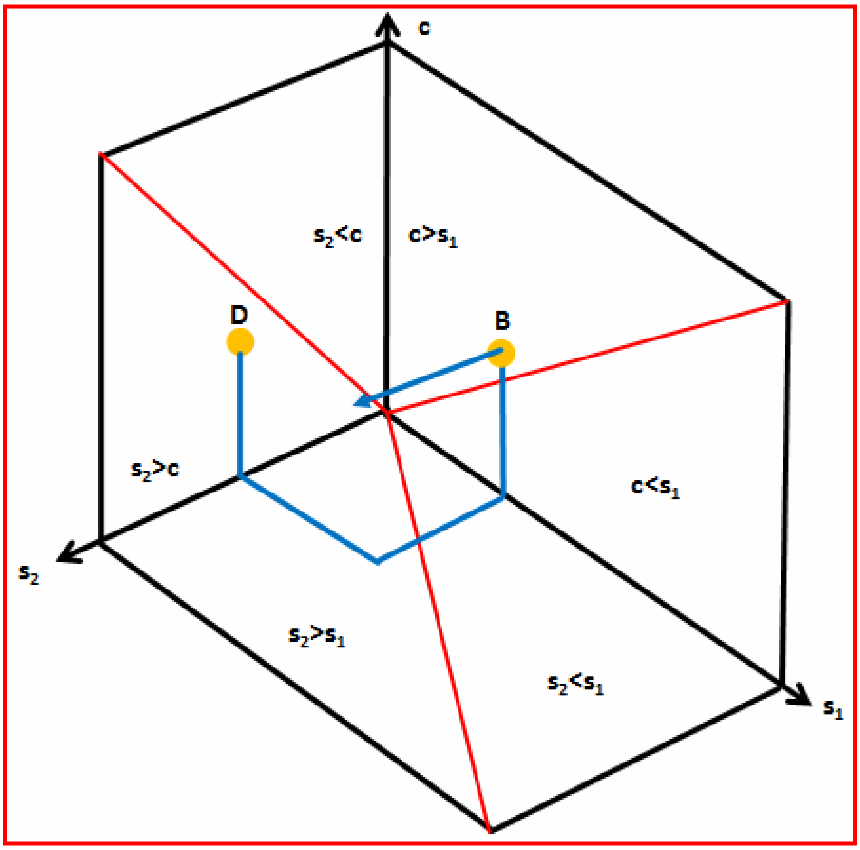


Figure 14. In this picture the transfer space is deformed so that the subject will judge the side s_1 “giving” and s_2 “taking” as reasonable. Also the system view s_2-s_1 looks now good (productive). Here the transfer BD will be realized.

This surface (s_2-s_1) however has a big attraction as an argument. Many ideologies argue that certain individually harmful behaviours will be productive to the group, the country or the whole world. The interior of the transfer space must be understood. The simple observation of the surface is not enough. The transfer space is much more complex and has areas where unexpected outcomes appear, especially when the space is not linear. In addition there are many different transfer spaces within every economic entity. Sometimes unrelated transfer spaces are mixed, reasonable and coherent decisions are not to be expected in such cases. In general the final benefit (b) to cost (c) ratio for organisms and societies (ensembles) must be larger than zero ($b/c>0$) to lead to stability and growth. The benefit could be interpreted as the productivity

(+p or -p) per used substrate (variable cost, S). The cost (c) is the total cost (fix cost) considering the degree of saturation there.

- Arms race

In an escalating arms race increasing amounts of productivity are invested into the ability to withstand brute force. These adaptations are costly (Dawkins R. and Krebs J. R., 1979). The amount of indispensable fix cost (c) is increased for both sides. The source prevents “to give” and the sink prevents “not be able to take”. Both adaptations make the transfer space grow in direction of the c axis. More and more variable cost is transformed to fix cost. (The size of s_2 and s_1 may stay the same if there is an identical size relation in a symmetric arms race.) Increasing the amount of fix cost makes the degree of saturation larger there. High saturation is connected to low productivity of additional variable cost. The arms race will end when the value (productivity) of an additional substrate is smaller than the variable cost for this substrate. The arms race ends sooner or later in exhaustion or defeat. In a symmetric arms race the transfer space and saturating production functions may be for both sides very similar. A symmetric arms race should end when arming confers the same amount of advantage and disadvantage.

We do not generally observe this. Between different species/populations the race may persist because the space looks different for both sides (asymmetric) and changes over the millennia.

If the arms race between two parties does not involve a fertility race, fertility itself can be regarded as a variable cost paying the price of arming. Fertility under starvation is very often considered a variable cost in life forms with more than one broad season and care for the broad. After a missed breeding season there will be another chance. Sitting starved to death on eggs does neither help the eggs nor the breeder.

- The external energy source

All actions of life depend on the external energy from the sun (a few exceptions exist). The suns energy is collected by plants and handed over from consumers of different levels to man in the food chain. The loss of energy in each step is about 90%. The empirical law of mass and energy conservation is strictly obeyed on all levels! On each level of the food chain the residual 10% are handed over via consumption of generated surplus in form of offspring or offspring related products. Only two offspring per parents will survive statistically under stable conditions. The rest is consumed and transformed into productivity and activity of the next trophic level. Man is the final stage of the food chain (usually). If man invests all collected energy and substrates into offspring, density dependent problems will arise (aggression, disease, starvation). Man can also transform the substrates and energy into other activities (manufacture, construction, art, science, etc). But energy and material can be spent only once for physical activity or reproduction and related activities. Productivity will result either in offspring or in economic productivity or a mixture with less offspring and suboptimal economic productivity. The transformation process leads to a decrease in fertility as recently published (Myrskylä, M., Kohler, H.-P., Billari, F.C., 2009). The transformation process comes to saturation at an offspring amount between three and two as expected. A speed limit is reached when all substrate and energy determined to produce offspring is converted to economic activity. If all activity is transformed into economic productivity the productivity (s_2=max; no reinvestment into the stability of the source) will be maximal for a short while and then the ensemble will break down (s_1 max, then s_1=0, s_2=0) if no influx of new exploitable entities follows.

- The time course of interactions in the transfer space

In the exploration of the transfer space I have mainly concentrated on the surface: the source, the sink, and the outcome for the system. To understand the dynamics of this space it is necessary to look at the inside and the time course of interactions.

Economics and biology share similarities (Witt, 2006). The fact that economy is created by a living organism (man) may be a reason. Biochemistry and economics share similarities, too. In both areas saturating production functions are usually observed (Figure 15).

Figure 15

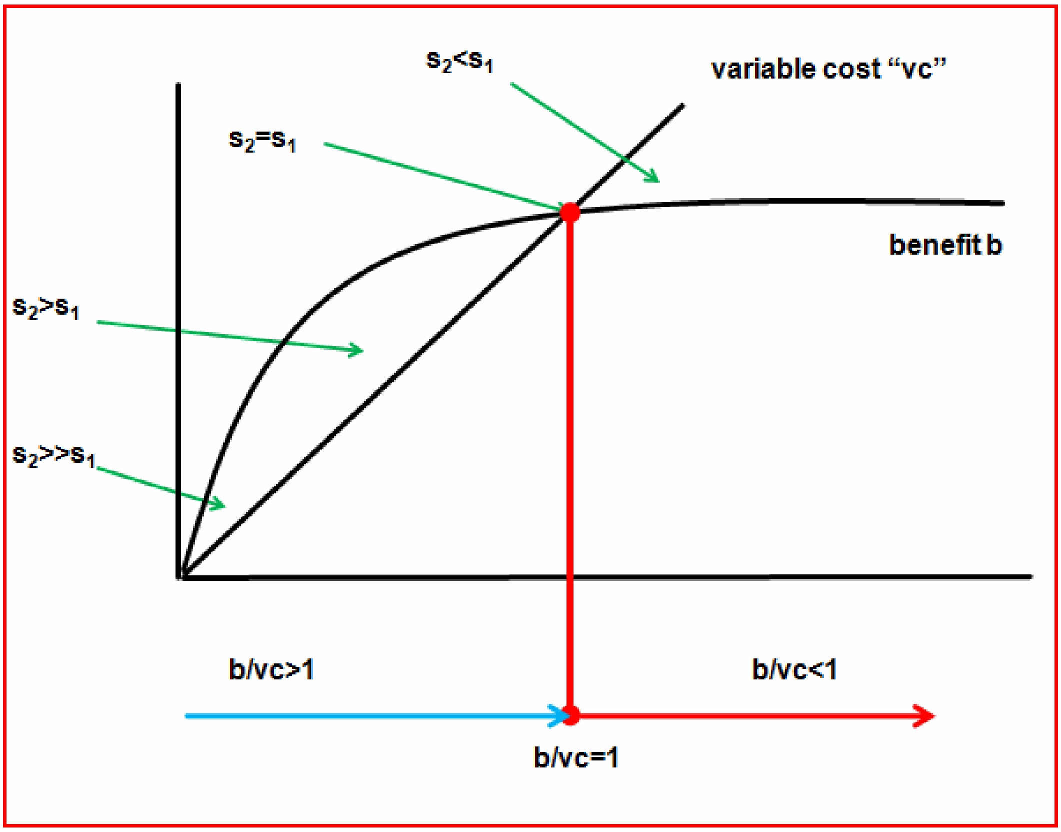


Figure 15. In this figure substrate input (variable cost, vc) is compared to productivity output (benefit b) at different degrees of saturation. We observe two regions: on the left side b/vc>1 at low saturation (such a substrate is not given away but taken); on the right side b/vc<1 at high saturation (such a substrate is not taken but given away). If we take away the variable cost from the source and invest the variable cost in the sink to be productive there the outcome for the system is $s_2>s_1$ on the left and $s_2<s_1$ on the right side of the point of equivalence ($s_2=s_1$).

When I discussed the surface of the transfer space I looked at the productivity of the additional substrate (variable cost) dependent on the saturation (fix cost) already reached in source or sink (the two sides of the space). The ground of the space showed the outcome for the system. To discuss the inside of the space one must understand that all three variables have to be taken simultaneously into account and that they are connected. The ensemble as entity is characterized by a continuous gain of productivity in the sink coupled to a continuous productivity loss in the source (Figure 16) at a certain cost and changing saturation in both in the course of time.

Figure 16

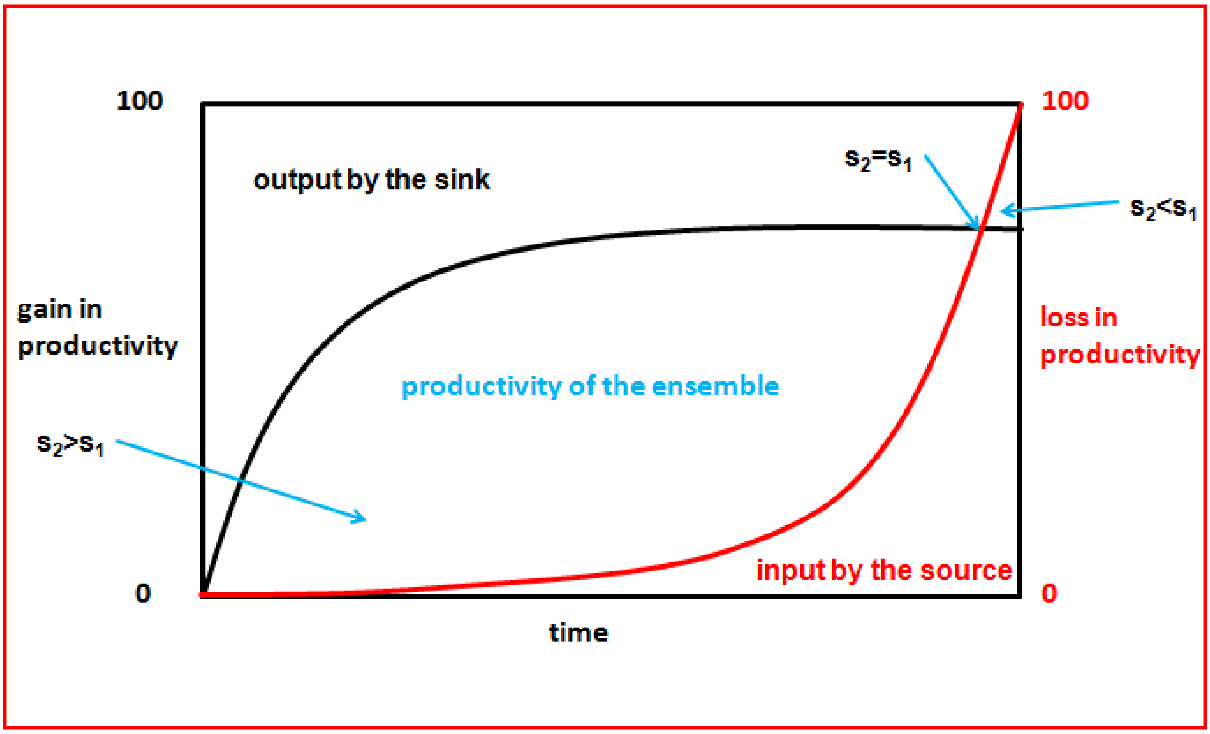


Figure 16. This is a partial view of an ensemble, the inside of the transfer space. Source and sink share a similar production function. In the beginning, on the left side of the graph a small loss of productivity in the saturated source is overcompensated by far through a big gain in the sink ($s_2>s_1$, productive exploitation). In the course of time more and more substrate is transferred from source to sink. In this example the variable cost in the source is chosen to be very steep and in the sink very flat and both meet in $s_2=s_1$. Left of $s_2=s_1$ we have giving and taking; on the right side of $s_2=s_1$ we have taking not and giving not. The transfer ends in this example in the point $s_2=s_1$. Consumptive exploitation will therefore not be observable and brute force or education is not necessary.

The simple saturating (Michaelis-Menten) type of behaviour is very ideal. In some enzymes we do observe the maximal reaction velocity near zero substrate concentration ($s_2 >> s_1$). In the real world we observe a different behaviour especially near the start. Besides simple saturation curves sigmoid behaviour is observed in economics and biochemistry (Figure 17). This type of behaviour seems to be more realistic.

Figure 17

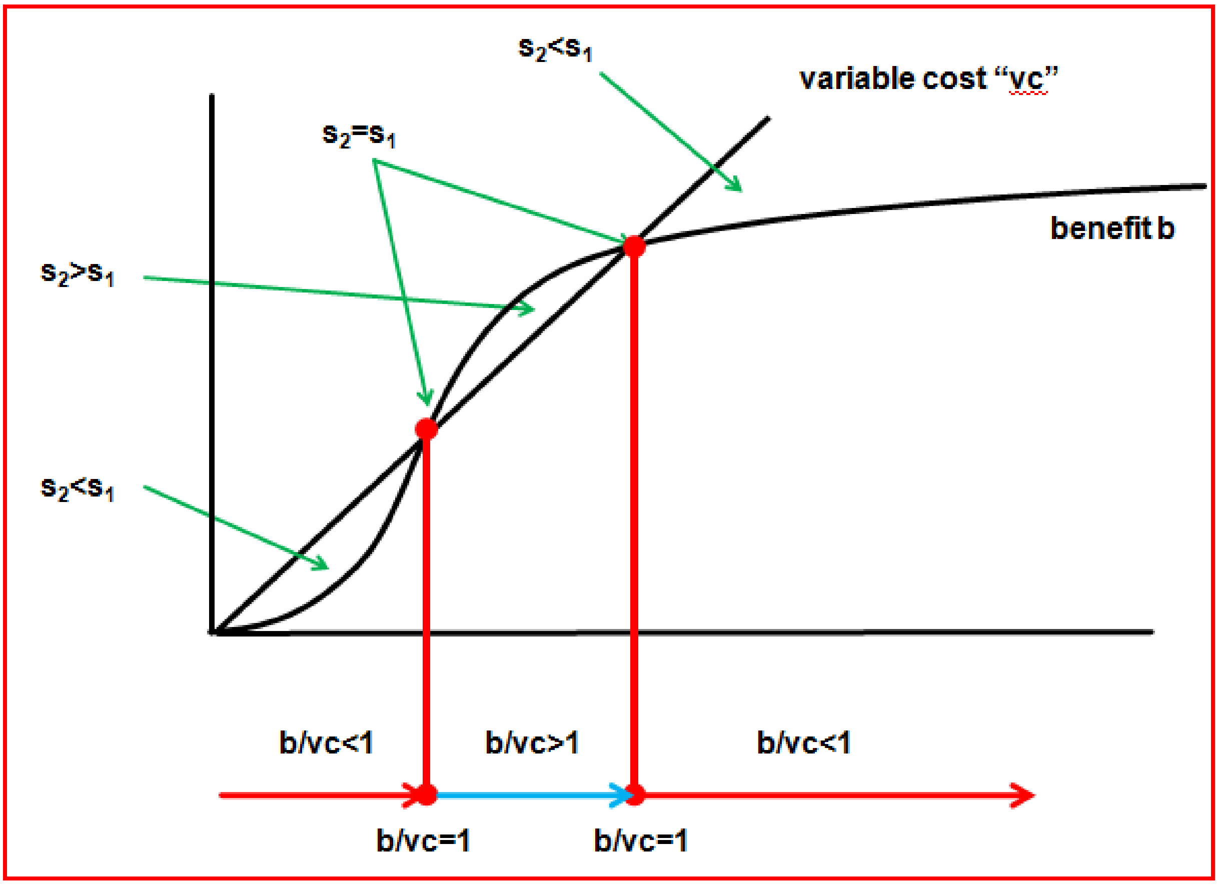


Figure 17. The saturating productivity (benefit b) here has a sigmoid shape. The variable cost (vc) is a linear function. Both functions have two crossing points with b/vc=1. On the left side between zero and b/vc=1 we find consumptive exploitation (b/vc<1). This region is followed by productive exploitation (b/vc>1). Finally, after the second crossing we again find consumptive exploitation where the b/vc ratio is smaller than 1.

In this sigmoid behaviour there are two points where the ensemble productivity changes between production and consumption forth and back (Figure 18).

Figure 18

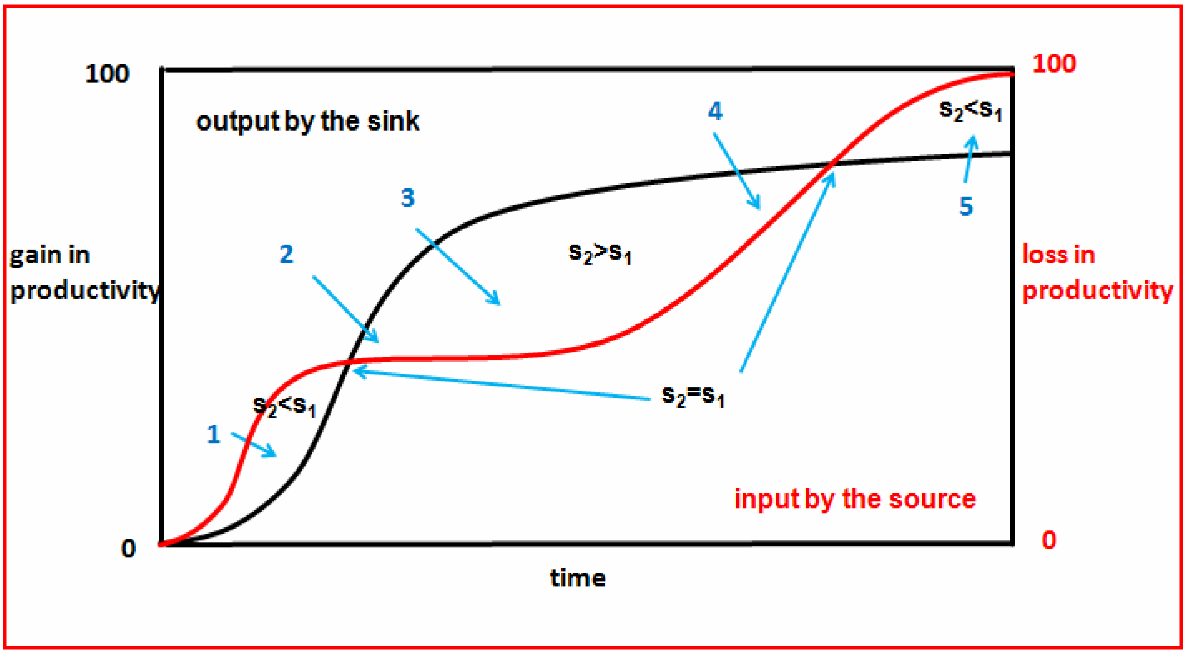


Figure 18. In the beginning of the temporal development the loss in productivity of the source is not compensated through the gain in productivity in the sink (1). The ensemble shows a consumptive behaviour. Later the loss in the source is much smaller. Maybe reserves are being activated. A very productive phase of the ensemble starts here (2, 3). Then the productivity in the source decreases again and the sink does no longer overcompensate that (4). The reserves may be exhausted. Finally the ensemble enters a phase of consumptive exploitation again (5). This transfer may be induced by brute force or education. The fix cost and the variable cost is not considered here.

A sigmoid productivity has important consequences for the dynamic behaviour of the ensemble within the transfer space. To observe this and the fate of a single ensemble-feature, let us travel through the transfer space (Figure 19). We follow the ensemble productivity within the transfer space during the course of time when e.g. brute force or education transfers increasing amounts of substrate from a source in $c<s_1$ (loosing productivity and becoming more unsaturated) to an unsaturated sink in $s_2>c$ (gaining productivity and becoming more saturated).

Figure 19

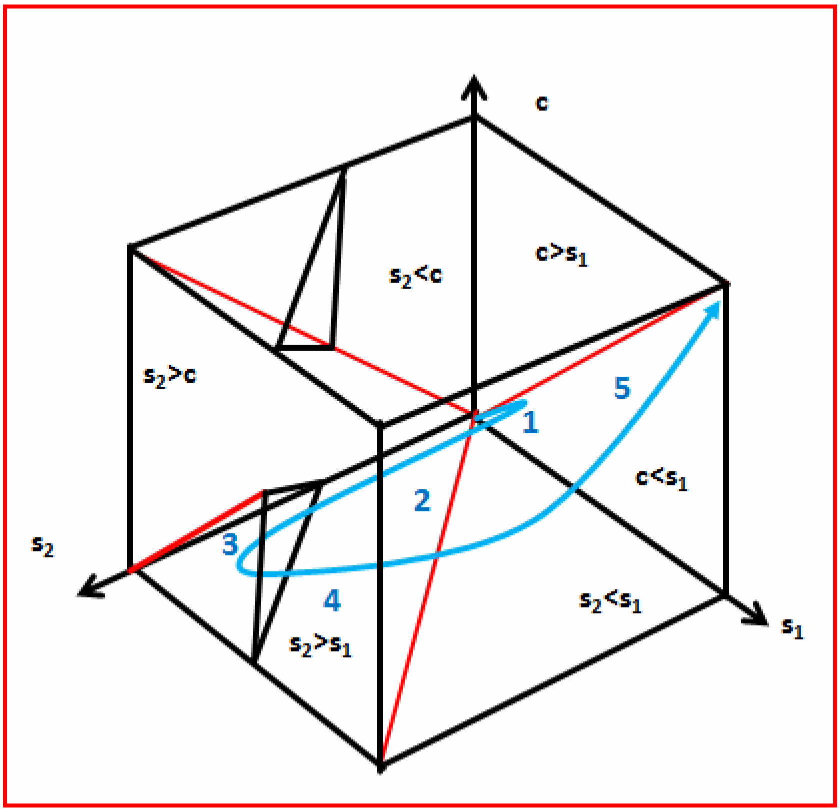


Figure 19. The blue path of ensemble productivity (a single feature) starts at the origin, $s_1=s_2=c=0$. The complex behaviour is the result of sigmoid production functions in source and sink, a single interaction in the course of time. The ongoing decrease of saturation (productivity) in the source is connected to continually rising saturation (productivity) in the sink and rising fix cost in both. In this example the fix cost (c) seems to be all the time smaller than s_1 ($c<s_1$). Brute force and education is necessary to realize the transfer. The sink will take all the time as $s_2>c$. The same path would be obtained if we would observe the tip of the vector in figure 12 wander through the transfer space while more and more substrate is transferred and the fix cost rise.

We start in a consumptive ensemble with a small, not earning transfer from source to sink (18,1; 19,1) – a case of consumptive exploitation with a promising future. Valid hope for improvement may guide the hungry sink and the source, also hungry but convinced of a necessary sacrifice. Increasing the transfer will decrease the loss and finally become earning (18,2; 19,2). The region of productive exploitation is entered. Always on cost of the source, the ensemble is productive.

Increasing the transfer further may lead to the subspace of wise exploitation where long term stability through reinvestment is possible

(18,3; 19,3). Here the sink earns a stable reward and the source has a stable payback. This payback is the result of a transformation process (e.g. offspring is converted to consume; quantity is converted to quality) and a productivity increase. The ensemble (the invisible third party) is maximal productive with regard to this feature and stable. Now no further transfer should be made. This could happen even in the absence of reason when the size relation in the sink changes from $s_2>c$ to $s_2=c$.

Although the ensemble has arrived at its maximal productivity with respect to the considered feature, the sink may be involved in a direct arms race with another party (not an indirect arms race with a second ensemble!). The sink has to increase its own productivity.

The journey goes on. The sink tries to improve further as an increase in sink productivity is still possible. The ensemble moves back to productive exploitation. The ability or the will to reinvest has ended. The productivity of the ensemble decreases (18,4; 19,4). This may go undetected as the abolished costing reinvestment into the source under the regime of wise exploitation may compensate for that. Desperately and with the best intentions the sink tries to improve (verschlimmbessern, kill the patient with the cure) the transfer from source to sink. Force and counter force as well as increased educational efforts may increase the indispensable fix cost (c) on both sides. Though the productivity in the sink is still increasing, the ensemble reaches the area of consumptive exploitation again at much higher fix cost (18,5; 19,5). Increasing the transfer further is hopeless but will be done with all efforts and hope – maybe even with the excited consent of a well educated source. Finally the source is exhausted and the ensemble will lose productivity completely (s_1 max, then $s_1=0$, $s_2=0$) when the source collapses. The size of the fix cost in source and sink will determine whether the ensemble path is above or below the border $c=s_1$ and $s_2=c$. This is important as it decides whether brute force and education have to be used in the source to induce giving in $c<s_1$ or the sink to induce taking in $s_2<c$.

What surprise may wait on a travel through an “ensemble space” with many features, complex saturation functions different in many sources and many sinks at different fix costs in sources and sinks with additional variables influencing c, S and p. When we look at interdependent ensembles and sub-ensembles in direct and indirect competition and their development over time – it may look like evolution or human history.

Interpretation

Enzymes

Enzymes are biological catalysts. Their production function is a saturation curve. The behaviour is predictable by thermodynamics and reaction kinetics. In a test tube their activity and productivity depends on external physical and chemical parameters (pH, temperature, substrate concentration, product concentration etc) and intrinsic features (substrate affinity, specificity, etc). Source and sink in the test tube depends purely on reaction kinetics. If a system of identical enzymes is not well mixed there may be local substrate concentration differences and therefore productivity differences. This system is not Pareto efficient. The combination of local substrate depletion ($S+p>0$) with high productivity potential and local substrate surplus ($S+p<0$) with low productivity potential will lead to a higher overall activity after mixing. After mixing differences in productivity are due to differences in intrinsic features.

Now the system is Pareto efficient. Enzymes never give beyond the border to prisoners´ dilemma ($c=s_1$; $0=S+p$) in a well mixed solution. A thermodynamic view of economy has already been developed. (Eric Smith and Duncan K. Foley, 2005) Enzymes are important active building blocks of organisms.

Organisms

Cells and organisms are partially closed and not identically equipped. The enzymes in their bodies are in different states of saturation. This different degree of saturation leads to different behaviour. Only hungry animals graze or hunt. Many enzymes in their bodies are not saturated. Saturated animals will not graze or hunt because their enzymes are saturated.

Brute force is a fact in animal societies. (Clutton-Brock, T.H., 2009 and Clutton-Brock, T.H. and Parker, G.A., 1995). Animals respond to brute force from other animals. They will not feed or mate and leave the opportunity to dominant animals. Brute force is an investment by the dominant animal and will not be used all the time as fear will be induced. Fear makes the subdominant animal obey. Brute force in intra species conflicts is generally observed and therefore evolutionary stable. What is the reason?

Dominance is a result of mutual aggression and fight. Dominant animals have been successful in such conflicts. Therefore, their genes must be fitter. They are more productive (e.g. more muscles, faster reactions). Taking away food from weaker animals will only increase the productivity of the ensemble if: $s_2-s_1-bf>0$. This seems to be the case because we observe many species with this behaviour. Why is that so? The consequence of the law of energy and mass conservation is that mass and energy will stay either within one species/population or they are transferred to another species/population. Weak animals are either consumed partially or completely by another species (e.g. pathogen, predator) or they are “consumed” by their own species. This seems to be of advantage to ensembles with brute force as investment. Material and energy stay in the same species/population and are productive there.

Organisms of different degree of complexity take care for their offspring – others not. Infanticide with cannibalism is observed (Bluffer Hrdy, S., 1979) – this is a surprise. Altruism is not generally observed and it is not dependent on complexity. Could there be another reason for genetically founded altruism? Highly productive organisms produce much offspring. They do not take care but sow the offspring. It would be expected that high productivity is connected to low saturation. Organisms with scare offspring invest the productivity not completely into the production of progeny. Therefore they are more saturated. In saturation the productivity of the ensemble of progeny and parent will become higher if material and energy is transferred from the saturated partner (parent, source) to the unsaturated partner (offspring, sink). Not only genetic tradition but also economics makes parental care under saturated condition a successful behaviour. Now we can interpret infanticide with cannibalism differently. The flow of material and energy is reversed when the probability of a successful investment due to a dangerous environment (stress) has become too low.

The economic decision process in man has rational and irrational components. The rational decision to give or to give not (money, goods, help) and take or take not (money, goods, help) depends on the expected outcome ($s_2>s_1$ - get more than give away or $s_2<s_1$; the ensemble is here the individual simultaneously exchanging money for goods). The expectation is either realistic or not realistic. This depends

on the quality and intention of the underlying information (cultural tradition, neutral or intentional information by others, etc).

Societies

Man seems to behave completely unexpected. Enzymes behave rational controlled by thermodynamics - man does sometimes not. Man does not have all information necessary and big parts of information given to him (cultural tradition, personal information by others) are systematically aimed to manipulate and disguise him. Education and emotional conditioning is able to modify the behaviour in a way that individual harm is the outcome. The group may have an advantage. Emotions are a product of man´s evolutionary history. They summarize complex situations (gut feeling) and are prone to be manipulated.

The degree of saturation is difficult to determine in complex multidimensional systems. On the background of different genetic and informational equipment two parties with the potential to exchange goods meet. Both sides give and take, do not give and do not take. The fix cost, the variable cost and the productivity is different on both sides. Information of different quality (wrong by accident, deliberately wrong, partially right, right) is processed on the background of different educational conditioning and prejudgments. In addition, cost, productivity and informational content change within time and in dependence of former decisions. The result is a complex, non linear, constantly changing space. The outcome of exchange decisions is partly rational and seems partly irrational with severe consequences for the individual and the group. A rational decision to give (optimize own productivity) may be wrong because the underlying information was intentional wrong to induce giving. Suffering of the source (biologically or personally) will give a reward to the sink and may foster the productivity of the group.

Economic growth seems to be a transfer of material and energy from reproduction to production. The success of a group may relay on the suffering of individuals. But suffering of the source will not guarantee the productive success of the group – it may only serve the consumptive well being of the sink. As always in evolution - success is a feature of the successful - the timescale has to be observed. Emotions could be a by product of evolution. Emotions (fear, love, pride, etc) reduce the fix cost in the induction of giving, not giving, taking and not taking. A reduction of fix cost will increase the productivity of this group.

Information

The transfer space is easily deformed by information as I have demonstrated. In a deformed space it is no longer possible to make reasonable decisions to give, give not, take or take not. True information is central to a reasonable behaviour in source and sink. If this information is independent from source and sink the probability that even incomplete information is useful is very big. However, if e.g. a government (sink of tax) or ideology controls the press it is no longer possible for the citizens (source of tax) to make the right judgment (good productivity of the ensemble). Another example: banks. The original task of a bank is to collect money from a saturated source and hand it over to a productive sink with a good forecast for a reward to the source, to the sink and to the honest broker. As soon as the bank becomes the sink the source can no longer relay on the validity of the forecast for a successful investment. Not the ensemble but only the sink will benefit. The source of information must be independent.

In fully integrated ensembles like organisms the survival of the genetic information of all sources and sinks (enzymes) is an absolute criterion that the transfer space of single components is not deformed.

Summary

A saturated source with usually high fix cost and low productivity will give voluntarily to a not saturated sink to reduce not earning variable cost and optimize own productivity. The transfer of a substrate from a saturated production function to an unsaturated production function leads to a productivity increase of the ensemble. This is called productive exploitation. The collective advantage may help that the ensemble will prevail against competitors. The productivity gain however is controlled by the sink. The source will give voluntarily until prisoners´ dilemma is reached.

The asymmetry of the beginning and the control of the gain enable the sink to exploit the source further to completeness using brute force or education not to detect prisoners´ dilemma. When the investment into brute force and education is overcompensated through the gain this is called wise exploitation. The sink will use the gain to exploit new sources as long as they are available. When all sources are completely exploited the system will collapse. Stability here is dependent on the continuous influx of new exploitable sources. This reminds of a predator-prey system in biology.

A lasting, self sustaining stability is reached when the gain from the transfer is big enough to pay besides a reward to the sink the necessary reinvestment into the stability of the source. The source is preserved through breeding on the long run. This is also called wise exploitation. The reinvesting system will prevail against the exploiting system on the long run but not in direct confrontation.

Saturation is a rare event in the real world, there rarely is Pareto efficiency. A source may also be already in prisoners´ dilemma and will

not give. Here also brute force or education to not detect the loss may be used from the beginning to change the behaviour from “not giving” to “giving”. Starting in prisoners´ dilemma is attractive as the fix cost is low. The price is paid by the source and the gain is controlled by the sink. Productive and consumptive exploiting systems as well as sustainable systems in combination with breeding may originate here also. The reward in productive exploitation is always larger than in wise exploitation. Sustainable systems will only prevail in indirect competition as brute force, education and breeding are costly but last longer. A saturated sink with high fix cost and low productivity will not take deliberately. The reasonable sink will only take when it pays. But also the sink can be manipulated to take and harm own productivity.

Classic game theory is only a small slice of a whole transfer space. The prediction and interpretation of behaviour on the basis of classic game theory must lead to confusing results and unexplainable observations as there are several more behavioural types than usually assumed. Unselfish or genetically founded altruism is no longer needed as an explanation to give. Self-interest motivates “giving”, “giving not”, “taking” and “taking not” equally. The central fitness aspect of an ensemble is the transfer of substrates from a source to a sink with a better productivity. Reinvestment of parts of the gain leads to ensemble stability. The increased productivity will lead to domination of weaker ensembles or single parties without additional resources. The transfer space is able to explain the effect of brute force and emotional as well as informational manipulation of source and sink. Besides the Nash equilibrium a stable island is described. Wise exploitation and true symbiosis form this subspace of the transfer space. For a long time selfishness and group selection seemed to be incompatible. The transfer space is a tool to understand exploitation and egoism based group selection.

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