Transfers by force and deception lead to stability in an evolutionary learning process when controlled by net profit but not by turnover

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An evolutionary process is characterized by heritable variation through random mutation, positive selection of the fittest, and random genetic drift. A learning process can be similarly organized and does not need insight or understanding. Instructions are changed randomly, evaluated, and better instructions are propagated. While evolution of an enzyme or a company is a long-lasting process (change of hardware) learning is a fast process (change of software). In my model the basic ensemble consists of a source and a sink. Both have saturating benefit functions (b) and linear cost functions (c). In cost domination (b-c<0) source gives substrate and in benefit domination (b-c>0) sink takes it - both at free will - thus creating a basic superadditivity. It is not reasonable to give when b-c>0 or take when b-c<0. However, with force and deception source and sink of an ensemble can be overcome to give or take although it is not reasonable for them. This leads to further superadditivity within the ensemble. But now subadditivity will appear in addition in certain regions of the transfer space. I observe organisms or companies learning by trial and error to optimize superadditivity without changing the characteristics of the benefit function or the cost function. The role of a third-party master of an ensemble to create superadditivity in the absence of cost domination in source or benefit domination in sink by force and deception is investigated in connected and unconnected ensembles. Employees and companies can be rated according to turnover or net profit. My model confirms the superiority of the benchmark net profit as self-limiting, sustainable incentive in an evolutionary learning process.

ensemble, source, sink, transfer space, superadditivity, subadditivity, master

Introduction

One of the central ideas in science is the conservation of mass and energy: "*ex nihilo nihil fit*". My papers deal with the rearrangement of a conserved amount of substrate between two compartments with catalytic active entities forming an ensemble of a source and a sink (figure 1).

Figure 1

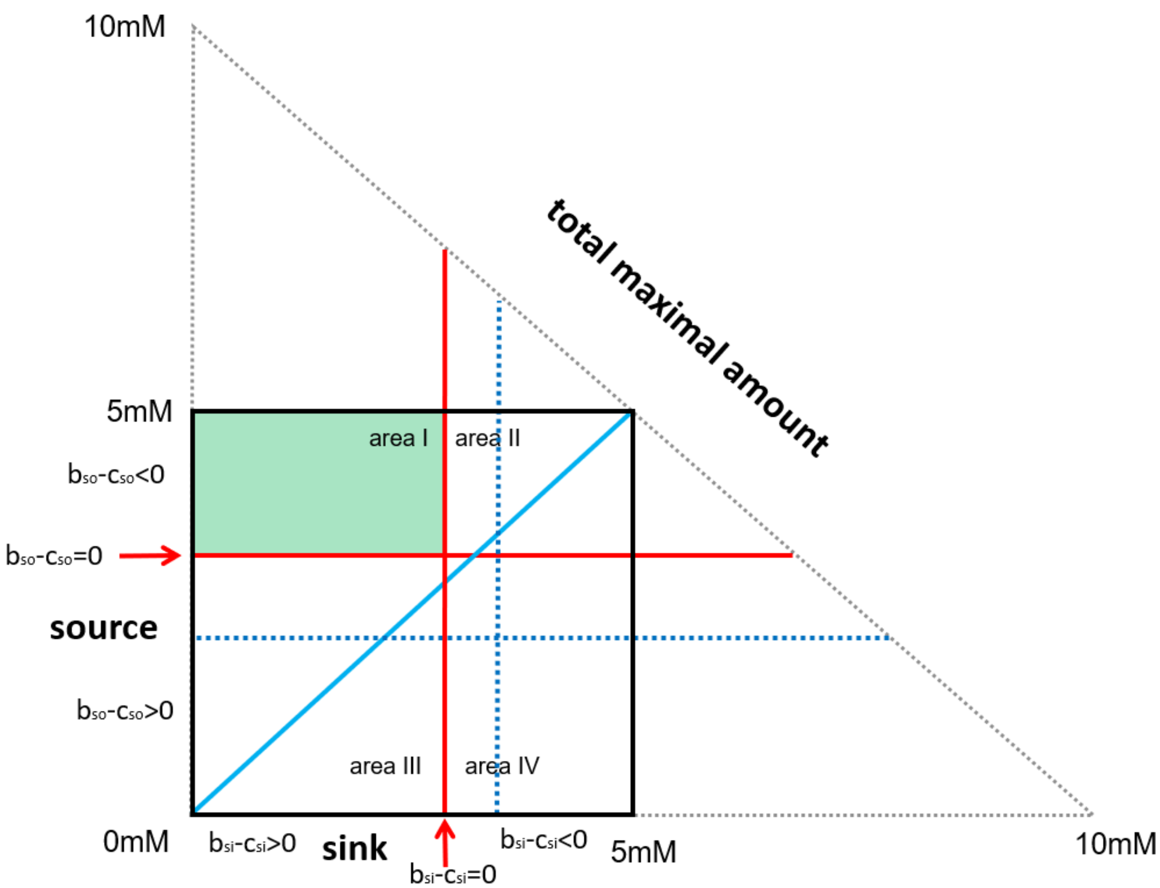

Figure 1

A top down view of the transfer space. The dimension net profit of the ensemble points towards the observer. An ensemble of a source (so) and a sink (si) share a fixed amount of substrate (maximal 10mM in total). Both sides separately consider cost (c) and benefit (b) of the substrate. The transfer between source and sink does not introduce an additional cost. The black frame is the observed concentration range (5mM) divided by two red lines (b-c=0) into four smaller areas: area I to IV. The green area is an area of peaceful transfers. Arbitrary new limits (target transfer size by force and deception beyond b-c=0) are indicated by blue dotted lines. The light blue diagonal is the line of equal substrate distribution. The ensemble shown has an asymmetric nature.

My model resembles the Solow model (1) with a saturating production (utility) function and a linear cost function but with three dimensions and two parties forming an ensemble capable to transfer substrate internally under control of the law of mass conservation. The characteristic of the saturating function does not stand on economic ground but on a similar biochemical ground which is the Michaelis-Menten kinetic (V=Vmax*[S]/(Km+[S])) in source and sink. This choice offers a way to separately (by mutation, 2) vary the steepness (Km) of the initial part and the height (Vmax) of the flat part of the saturating function. In addition, this is the basic form of productivity in all organisms. In my recent paper (2) I examined the evolution of organisms or companies viewed as ensembles of ensembles with a peaceful and rational behaviour of two Homo Economicus active only in area I of the transfer space (3) resulting in only superadditive net profit in symmetric ensembles. Weak asymmetric ensembles also show peaceful subadditivity in area I (the abstract was a little short here). Km, Vmax, cost factor (cf) and benefit factor (bf) differ in source and sink in asymmetric ensembles.

Area I is an area of peaceful transfers though not always superadditive and reasonable from an ensemble´s viewpoint. However, there is additional superadditivity in area II and area III (figure 1). This additional superadditivity comes with two types of additional cost.

1. Force and deception are investments to cross the limit b-c=0 which inactivates giving and taking behaviour. This time source and sink are not completely informed and not absolute strong; they can be overcome. It is therefore possible with a limited investment to force and deceive them. In a skilful investment the gain for the investor but not necessarily for the ensemble will overcompensate the initial investment. Force and deception are an extrinsic cost. This type of cost will not be considered in the later calculations.

2. An increasing transfer beyond b-c=0 through force and deception will lead besides additional superadditivity to an increasing amount of subadditivity reducing the total amount of superadditivity coming out of area I to III. This will finally lead to complete subadditivity (3, 4). Subadditivity could be characterized as an intrinsic cost. This intrinsic cost will automatically show up in the later calculations.

These costs above are to be discriminated from the basic cost of the substrate, *i.e.* “c”. This type of cost is inevitable connected to the benefit, “b”. Benefit and cost are inseparable, opposing features of the substrate. They are two sides of the same coin, in which the cost looks to the past and presence of the substrate and the benefit looks to the future.

In the absence of a master, force and deception will be used by that party which has not yet reached b-c=0. The other party has already reached b-c=0 and therefore does neither take nor give anymore. The cost of the investment into force and deception and into countermeasures is not considered. Source (b_{so}-c_{so}<0) may force sink to take more (figure 2, blue arrows B, one and two steps from area I into area II but not IV) and sink (b_{si}-c_{si}>0) may force source to give more (figure 2 blue arrows A, one and two steps from area I into area III but not IV). Both, source and sink using force and deception, will not cross their own limit b-c=0, they will only force or deceive the other party of the ensemble to do so. Therefore, the ensemble will not enter area IV.

But here I will investigate a master behaviour. A master is a third party. The master is not active in catalysis or production. He is either an honest broker bringing source and sink together in area I (2) or he forces and deceives both, source and sink, to transfer beyond b-c=0 from area I into area II, III, and IV as the master does not respect any red limit, *i.e.* b-c=0.

There are two types of masters (4). A conditional and an unconditional violent and deceptive master. The conditional violent and deceptive master is at first an honest broker in area I (figure 2 left, green), a brokerage fee is not considered. He starts violence and deception at the limit b-c=0 outside of area I to his new limit (figure 2 left, blue area, dotted blue lines). The unconditional violent and deceptive master will force and deceive source and sink to transfer beyond b-c=0 already at concentrations in area I (figure 2 right, all blue).

Figure 2

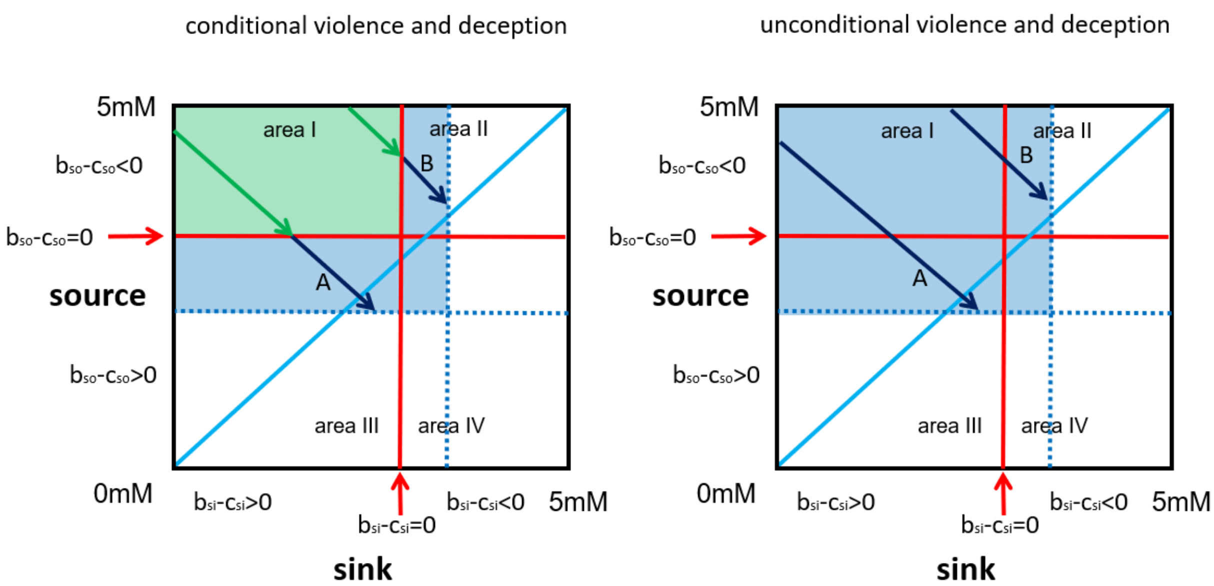

Figure 2

A top down view of the transfer space. The dimension net profit of the ensemble points towards the observer. Areas of peaceful transfers (green) and transfers by force and deception (blue) are marked. Exemplary transfers are indicated by arrows (green peaceful, blue with force and deception). All transfers finally end at a blue dotted limit in source and sink, a transfer size of an arbitrary example. Due to mass conservation – the amount taken from source equals the amount given to sink – the arrows run diagonally (volumes and other physical conditions in source and sink are identical). In both cases is the rational limit $b_{so}-c_{so}=0$ for source or $b_{si}-c_{si}=0$ for sink exceeded. Left: a conditional violent master with two steps; right: an unconditional violent master with one step.

This is an irrational behaviour as in area I force and deception are not necessary to induce transfers. However, this will produce additional superadditivity as soon as the border b-c=0 is exceeded. The intrinsic cost is an even faster growing subadditivity (5).

The effect of introducing a cost for force and deception is not considered here but was investigated earlier (4, 5). To cross the red lines (b_{so}-c_{so}=0 and b_{si}-c_{si}=0) will at first increase the amount of superadditivity further. When in symmetric ensembles the transfer will cross the blue line of strict equivalence (line of mixing of substrate) a small amount of subadditivity will appear in the centre of the transfer space. This is different in some asymmetric ensembles (figure 3). A further amount of subadditivity appears when the red lines to area IV are crossed. This is an area of complete irrationality where source in benefit domination is forced to give substrate to sink in cost domination. There are several ways - irrational and even rational ones - to create subadditivity as described earlier (2, 6).

In the previous paper I observed ensembles with the ability to change the characteristic values of “b” and “c” (Km, Vmax, bf, and cf) by mutation (or adjustment, bf as complexity factor, 2). The rational source and sink were only active in area I (2). In the following examples I observe cases where the saturating production function “b” and the linear cost function “c” are fixed again (Km, Vmax, bf, and cf values do not change by mutation). However, now the limit to which the master will force and deceive source and sink to transfer to will change. This is understood as a learning process guided by selection. The master of the ensemble learns to change the transfer size (size of turnover) beyond b-c=0. Selection will then either reward the increased transfer size or the increased net profit as result of a changed (a change can be an increase or decrease) transfer size. Independent of what selection will prefer, “transfer size” and “superadditive net profit” will be observed side by side over the generations.

What is net profit, superadditivity and subadditivity and how are they related?

According to the Cambridge English dictionary net profit is: *"the money made from selling something after all costs, taxes, etc. have been paid"*. Another definition found (Investopedia): *"Profit is a financial benefit that is realized when the amount of revenue gained from a business activity exceeds the expenses, costs and taxes needed to sustain the activity".*

In the second definition "benefit" and "cost" are used together like in my model. Benefit and cost have the same dimension (money or glucose) and by subtraction we determine the (net) profit. However, in economy a driving force is to maximize net profit. This stands in contrast to the behaviour of net profit in my model which behaves identically to the Solow-growth model. The system develops by redistribution (give cost dominated substrate, take benefit dominated substrate) towards an equilibrium of benefit and cost (b-c=0), not a maximal difference. In case the characteristics of b or c change (*e.g.* by mutation or invention through research) the system will occupy in the absence of force and deception a new stable point; b-c=0. As an alternative I could use the expression "efficiency" instead of net profit.

I look with a biochemist´s eye on the concept of net profit. Enzyme and substrate are the core components. The enzyme-substrate complex is a Janus-headed thing and he is formed in source and sink. Excess substrate as well as excess enzyme are problematic. Source and sink as separate compartments will produce product. Substrate may be redistributed between them to increase productivity in both compartments. The cost is related to the acquisition and keeping of the substrate and the benefit is related to the product that will be produced. The size ratio of benefit and cost within the substrate depends on the actual concentration of substrate in source and sink and is fixed there but can be changed by relocation. The point b-c=0 is an optimal substrate to enzyme ratio. Within an ensemble the substrate is transferred and transformed. It is taken into the ensemble, redistributed between source and sink to avoid oversaturation or idleness and then it will be catalytically transformed. Redistribution is the key step to optimize the net profit within the ensemble. In a symmetric ensemble with unequal substrate distribution mixing is a simple way to optimize productivity. An optimal distribution will lead to superadditivity (additional net profit), a wrong distribution may even worsen the productivity (subadditivity) in comparison to no redistribution. Redistribution is a way to change the size of the net profit. Wise redistribution of substrate is a possibility to maximize net profit.

Superadditivity and subadditivity appear inside the ensemble and are related to the degree of saturation and kinetic parameters of both sides. Superadditivity and subadditivity have the dimension "np*mM^2", an integral of the volume between all possible net profits of an active and an inactive ensemble in a certain concentration range (here 0-5mM). Net profit is point like and belongs to a single concentration pair. Superadditivity and subadditivity also appear here and are the difference of net profit with transfer and without transfer at a single concentration pair. The dimension here is np. Although in my definition net profit (np) and super/subadditivity (np*mM^2) have different units they are practically identical. The difference is the scale; local versus global.

Superadditivity and subadditivity appear in different areas of the transfer space, sometimes simultaneously. To determine the final balance of many transfers within the given concentration range superadditivity and subadditivity are to be subtracted. The final value of an active ensemble may be superadditive or subadditive in comparison to an inactive ensemble in the observed concentration range or range of activity.

Results and discussion of the results

Superadditivity and subadditivity appear in the transfer space when net profit of an ensemble without transfer of substrate (inactive) and net profit of the same ensemble with transfer (active) are compared (figure 3). Ensembles can be completely symmetric according to the features of source and sink (figure 3, row B, E, H) or asymmetric. The transfer in the active area may be voluntary and induced by force and deception.

The first asymmetric type consists of a weak source and a weak sink, a weak ensemble (figure 3, row A, D, G). In this ensemble type source does not like to give (high Vmax or low Km or low cost) and sink does not like to take (low Vmax or high Km or high cost).

The second asymmetric type consists of a strong source and a strong sink, a strong ensemble (figure 3, row C, F, I). In this ensemble type source easily gives (low Vmax or high Km or high cost) and sink easily takes (high Vmax or low Km or low cost).

The parameters are:

Weak asymmetric ensemble, b-c=0 at 3mM in source, 2mM in sink,

Km=0.5mM, Vmax=5µmol/min in source and sink; cf=(10/7)c/mM in source and cf=2c/mM in sink, bf=1b*min/µmol in source and sink.

Symmetric ensemble, b-c=0 at 2.5mM in source and 2.5mM in sink,

Km=0.5mM, Vmax=5µmol/min, and cf=(5/3)c/mM in source and sink.

Strong asymmetric ensemble, b-c=0 at 2mM in source, 3mM in sink,

Km=0.5mM, Vmax=5µmol/min in source and sink; cf=(10/7)c/mM in sink and cf=2c/mM in source, bf=1b*min/µmol in source and sink.

Figure 3

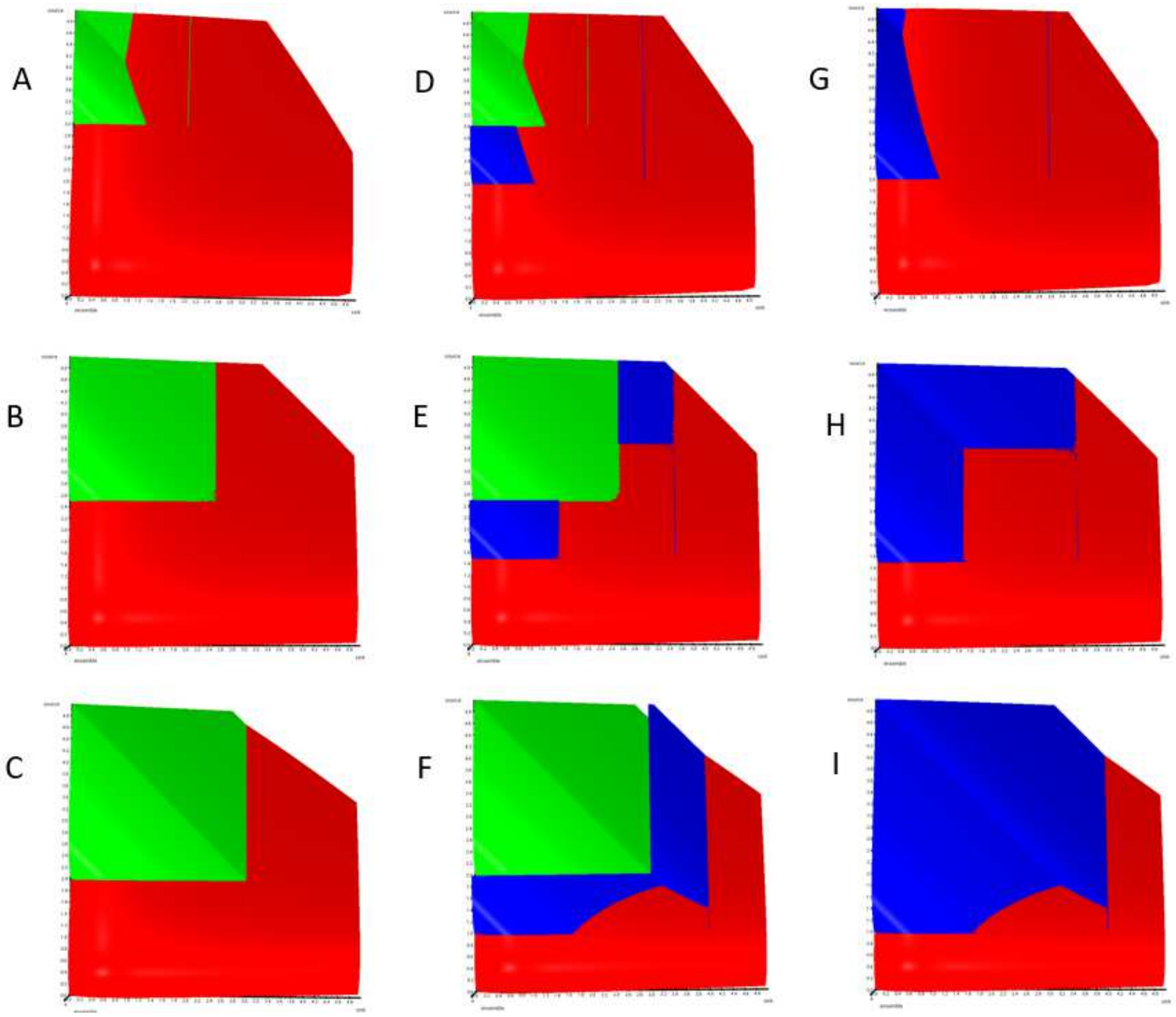

Figure 3

A top down view on several single ensembles and their transfer space. The dimension net profit of the ensembles points always towards the observer, source to the left, sink to the bottom. Red, no transfers, simple additivity; green, peaceful transfers (to the limit b-c=0 in source and sink); blue, transfers by force and deception (1mM beyond b-c=0 as example). Superadditive surfaces are above the red surface, subadditive below (not visible). The end of subadditivity is indicated by a thin green or blue line, an artefact where red, green or blue are of identical value.

Weak asymmetric ensembles: b-c=0 at 2mM in sink and 3mM in source, row A, D, G; strong asymmetric ensembles: b-c=0 at 3mM in sink and 2mM in source, row C, F, I.

Symmetric ensembles: row B, E, H; b-c=0 at 2.5mM in sink and 2.5mM in source.

Peaceful column (independent, no master, no force or deception) A, B, C; conditional violent column D, E, F (dependent on a conditional violent and deceptive master) and unconditional violent column G, H, I (dependent on an unconditional violent and deceptive master).

The ensembles in figure 3 were single ensembles from the type 1 in figure 4. In the following section I will mainly concentrate on ensembles of ensembles (figure 4-2 and 4-3) like in my previous paper. All necessary details of the calculations can be found there (2).

Figure 4

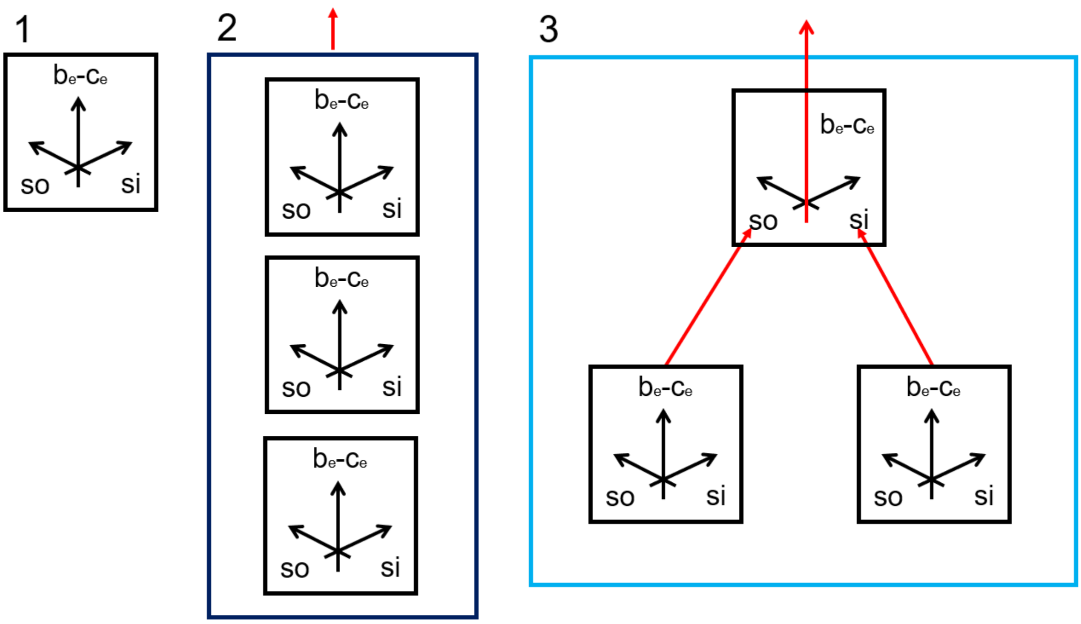

Figure 4

1: a single symmetric or asymmetric ensemble. It may be independent or dependent on a conditional or unconditional violent and deceptive master. The net profit of the ensemble is b_e-c_e and in comparing an active and an inactive ensemble we may observe superadditivity or subadditivity.

2: an unconnected ensemble of ensembles. Three ensembles of type 1 contribute together to the total outcome (red arrow) of either superadditivity and subadditivity or they contribute together to the total amount transferred when the master is interested in transfer fees.

3: a connected ensemble of ensembles. Two ensembles of type 1 feed as source and sink with their superadditivity a third ensemble of type 1. A master interested in net profit will participate in the net profit of the top ensemble and will be rewarded and observed accordingly. A master living on transfer fees will depend on the transfer size in the ensembles at the bottom and will be rewarded for an increase there. However, we are going to observe also the production of net profit of the top ensemble in that case. Red arrows indicate the flow of superadditive net profit within and out of the connected ensemble of ensembles.

The amount of superadditivity and subadditivity created depends on the type of asymmetry and the use of force and deception. Superadditivity as well as subadditivity appear in peaceful ensembles and by conditional or unconditional violence and deception without or with a master. A mixture of conditional and unconditional violence and deception is not investigated. Neither in the single ensemble nor in all three ensembles of the organism or company as ensemble of ensembles.

Besides a setting where all concentrations are of equal probability there is also the possibility that a substrate is to both sides of the ensemble either rare or in complete abundance. The ensemble will then only be active in area II or area III. We start with the observation of an equal probability for all concentrations (concentration pairs) in the range from 0 to 5mM in source and sink of all three ensembles.

Unconnected ensembles:

In the following section every organism is composed of three unconnected ensembles (figure 4-2). The population contains nine organisms controlled by nine masters. All nine masters are either conditionally or unconditionally violent and deceptive. Every organism is made entirely of ensembles of the type A (figure 3A, all weak asymmetric ensembles) or type B (figure 3B, all symmetric) or type C (figure 3C, all strong asymmetric ensembles) from the most left column in figure 3. This gives us the basic value of superadditivity corrected for subadditivity if present. Km, Vmax, benefit factors (bf) and cost factors (cf) are fixed and identical in source and sink of all 9*3 ensembles of a population. The masters (conditional or unconditional) are present but not yet active; this is indistinguishable from an independent ensemble. Then the masters start to learn to change the transfer size beyond b-c=0 in source and sink either by conditional or unconditional use of force and deception.

Transfers of the same size and direction:

The master learns to force and deceive source to give beyond b-c=0 (decrease of substrate concentration) and sink to take beyond b-c=0 (increase of substrate concentration) by the same step size. As result the superadditive net profit of the ensemble will change. The intersection of the dotted blue lines in figure 2 moves on a diagonal connecting the concentrations 0mM sink 5mM source with 5mM sink, 0mM source. The three starting ensembles in every organism have a maximal range of 3mM (A), 2.5mM (B) or 2mM (C) to transfer substrate within their respective borders. Savings, fat reserves, a storage or credit do not exist. Differing and independent step sizes on source and sink side are later investigated.

Two types of masters are observed: an all conditional violent and deceptive master (figure 3 D, E, F, figure 5) or an all unconditional violent and deceptive master (figure 3 G, H, I, figure 6). Every master will be punished or rewarded by selection for the result of his three ensembles. The three best masters and their ensembles will have one offspring each, the three next survive and the last three die. As we observe the evolution of a population of 9 masters and their ensembles the average of the nine outcomes (9*3) is depicted according to:

- transfer size (green) changed by mutation, always starts at zero
- net profit (blue), a result of the changed transfer, different beginnings

Either the increase of the transfer size or the increase of the net profit is rewarded in the evolutionary learning process. Observed is side by side the development of transfer size and superadditive net profit. The outcome is depicted always with the generation time as x-axis. The y-axis is either the transfer size (mmol) or the size of the superadditive net profit (np*mM^2) for both evolutionary ratings. In figure 5 we observe the learning process of 9 conditional violent and deceptive masters.

Figure 5

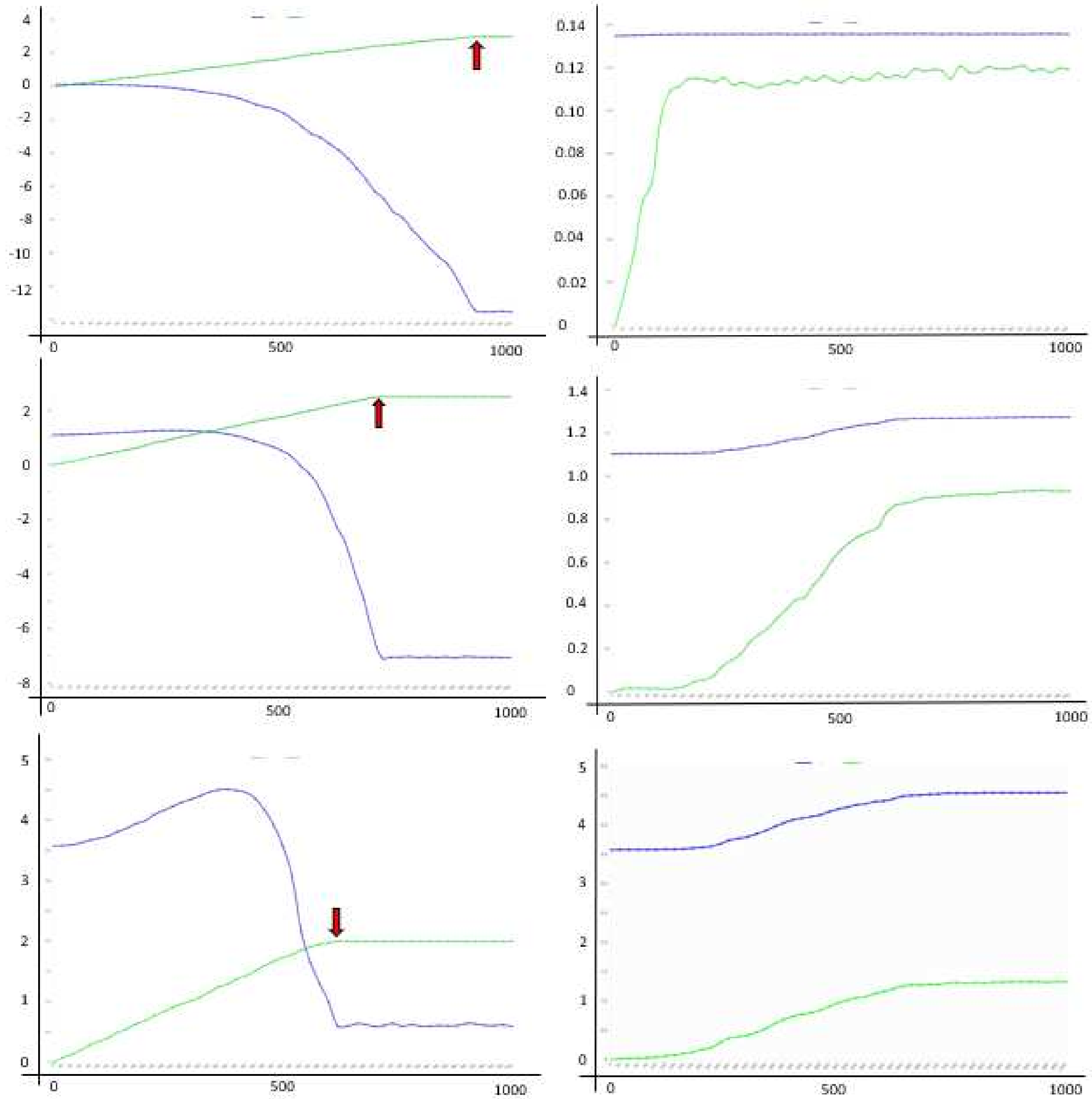

Figure 5

We look at the average of a population of nine conditional violent and deceptive masters and their unconnected and dependent ensembles of ensembles (9*3) over the time of 1000 generations (x-axis). The colours (blue, green) are not related to the usage of colours in figure 2 and 3. In the left column selection favours transfer size and in the right column selection favours superadditive net profit. The curves show the development of superadditive net profit (blue) and transfer size (green) over (generation) time. The pattern top to bottom is related to the pattern D, E, F in figure 3 (top, weak asymmetric ensemble; middle, symmetric ensemble; bottom, strong asymmetric ensemble). The number on the y-axis is either the amount (mmol) of substrate transferred (green) or the superadditive net profit (blue, np*mM^2) scaled by a factor of 0.1. The red arrows mark the endpoint of maximal transfer size possible.

In the beginning the master is an honest broker. He brings source and sink together, and they transfer at free will until b-c=0. A brokerage fee is not considered. Then the master learns that there is more superadditivity or more substrate to transfer. It is obvious (figure 5) that within 1000 generations the masters learn to increase either transfer size or net profit. However, the aim to maximize transfer size (figure 5 left column) finds no limit within the borders of the system independent of the ensemble type (symmetric, asymmetric). The system comes to an external limit (red arrow). There, additional substrate is no longer available within the ensembles and the increase in transfer size stops. The development of net profit is depressing. Net profit may go through a small or larger phase of initial increase but in the end net profit will decrease far below the starting value. This development stops when transfer stops. In two cases superadditive net profit is negative (subadditive) before the system finds its external limit. In the strong asymmetric ensemble, the final net profit stays positive (superadditive) but is far below the starting value (figure 5, left column, bottom). In the case where selection favours a better net profit (figure 5, right column) the system finds an internal limit and equilibrium. Net profit is maximized and then the increase of transfer size stops because more transfer would decrease the net profit again which is punished. In the weak asymmetric ensemble, the increase in net profit is barely visible (figure 5, right column, top) as the amount of subadditivity produced by this type of asymmetry is already considerable at the start. The starting value of superadditive net profit is 1.35 np*mM^2 and does not increase detectable while transfer size increases only a little. The situation in figure 3 D (transfer size of 1mmol) is a possibility only for the case where selection favours transfer size. The net profit of the whole ensemble is already negative at that transfer size.

In figure 6 we observe 9 unconditional violent and deceptive masters.

Figure 6

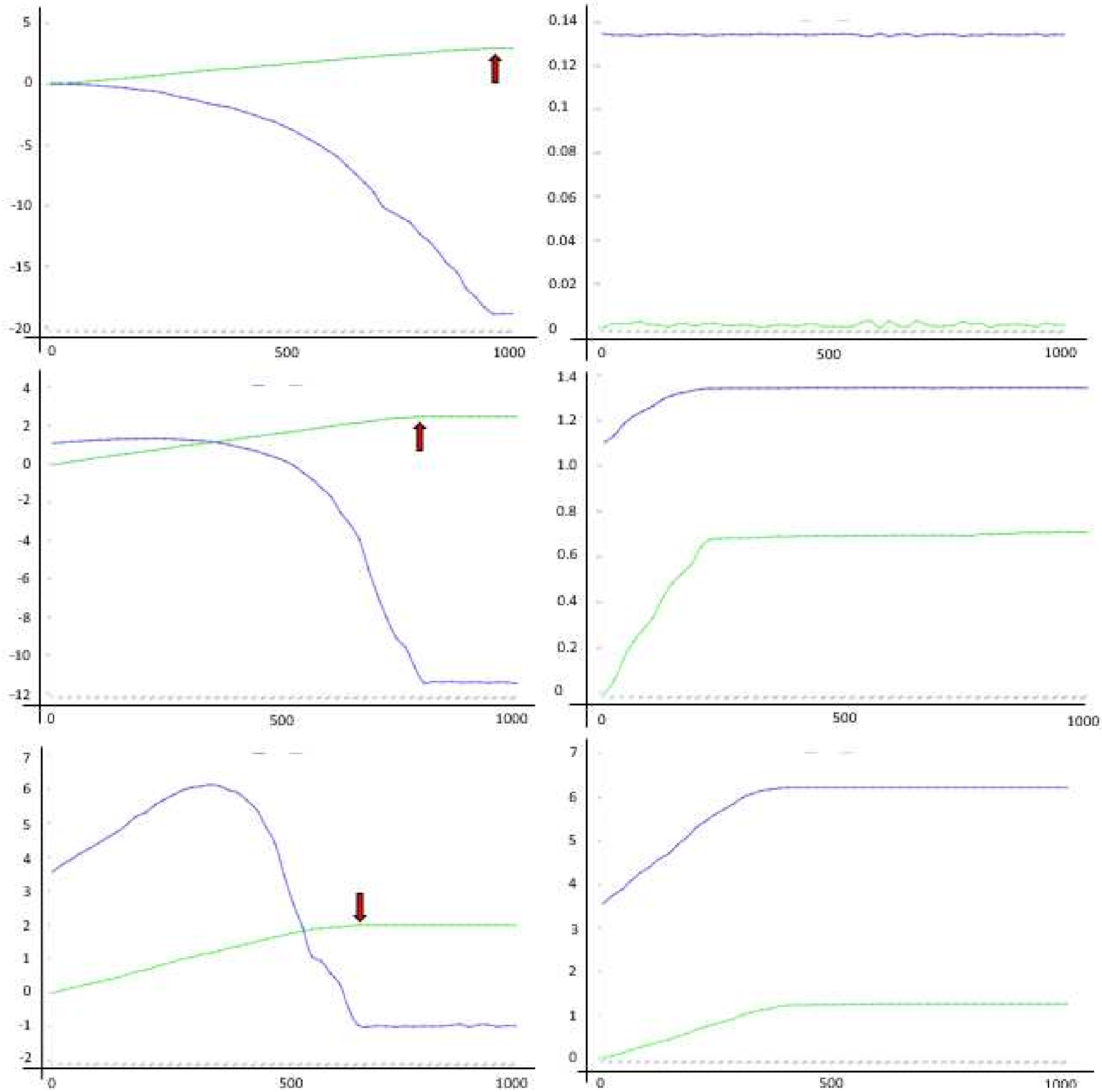

Figure 6

We look at the average of a population of nine unconditional violent masters and their unconnected and dependent ensembles of ensembles over the time of 1000 generations (x-axis). The colours (blue, green) are not related to the usage of colours in figure 2 and 3. In the left column selection favours transfer size and in the right column selection favours superadditive net profit. The curves show the development of superadditive net profit (blue) and transfer size (green) over (generation) time. The pattern top to bottom is related to the pattern G, H, I in figure 3 (top, weak asymmetric ensemble; middle, symmetric ensemble; bottom, strong asymmetric ensemble). The number on the y-axis is either the amount (mmol) of substrate transferred (green) or the superadditive net profit (blue, np*mM^2) scaled by a factor of 0.1.

The observations with the unconditional violent and deceptive masters (figure 6) are very similar to the conditional violent and deceptive masters. But there are a few interesting differences. It is already known from my older work (5) that the superadditivity of this master will increase faster and to a higher level but will then also decrease faster and steeper. This was observed with symmetric ensembles.

Remarkable is the observation that within the weak asymmetric ensemble (figure 6 right column, top) there is no increase in transfer size and superadditive net profit. It was already clear from figure 3 that the amount of subadditivity produced is larger within an ensemble of an unconditional violent and deceptive master in comparison to a conditional violent and deceptive master. The amount of subadditivity is of the same size as the amount of superadditivity. The system can no longer react as every movement of the limit in either direction away from b-c=0 (shrink or grow) will increase superadditivity and subadditivity or decease superadditivity and subadditivity to the same extent.

The observations in figure 5 and figure 6 also explain a common misunderstanding of ideologists. In the beginning of some ensemble types an increase of transfer size will increase net profit. Simple minds start now to think in straight lines. However, there is an early end to this lockstep and that is not even the external limit. The simple thinking must end when net profit starts to break down. That is the point where realists and idealists separate.

In the preceding paper (2) it has already been learned that recombination does not change the basic outcome of the results. Evolution with recombination is just faster and this is well known from Biology. The data with mutation and recombination are therefore omitted.

Transfers of different size and direction:

In figure 5 and 6 the growth of transfer size and net profit of a weak asymmetric ensemble is neglectable or not present at all (figure 5 and 6, right column, top picture). The reason is the considerable amount of subadditivity produced right from the very beginning in combination with a master linking the step size and direction on the source side to the step size and direction on the sink side. This is changed now. On the source and sink side different step sizes and different directions on either side of b-c=0 are possible. Every single transfer is still controlled by the law of mass conservation. An illustration of this idea is presented in figure 7.

Figure 7

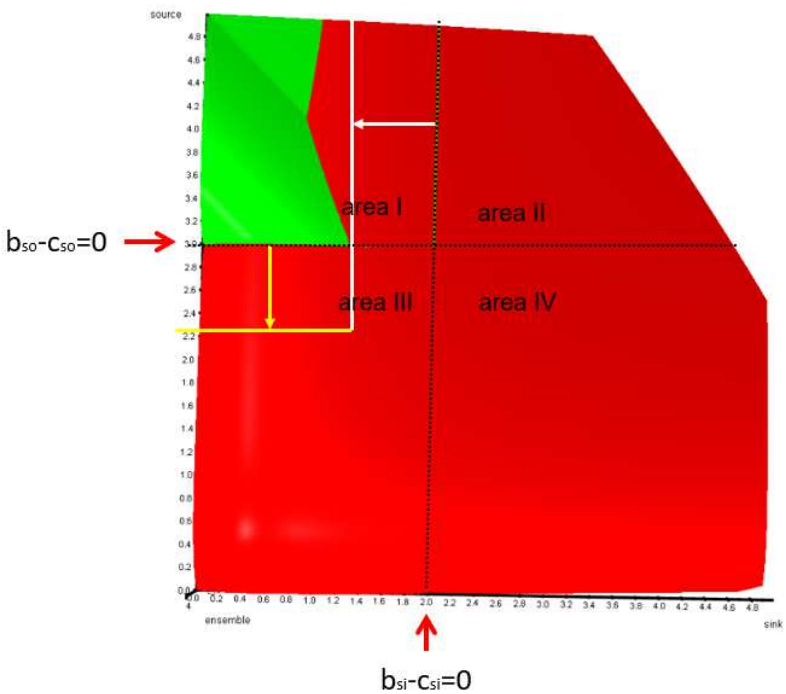

Figure 7

A single weak asymmetric ensemble is shown top down (source to the left, sink at the bottom, net profit of the ensemble towards the observer). This ensemble is already at the beginning partially subadditive (red over green in area I). The master is controlled by the aim to maximize superadditive net profit. Subadditivity will decrease (white arrow, shift of the border at the sink side further back into area I) while superadditivity will increase (yellow arrow, shift of the border at the source side, into area III).

The transfer space is a model that could be called an “outer model” or an objective, factual model. Such facts are Km, Vmax, bf, cf, the substrate and it´s concentration range. The outer model is inhabited by up to three parties. The outer model is the reality for source, sink, and master. The three parties must decide whether they become active or stay inactive. For this they need their own model. I call this an “inner model” or a subjective model. The inner model used by the master could be the only model to match the complexity of the outer model as the master is no component of the transfer space.

To determine concentrations is a simple way to orient within the transfer space. The inner model of a Homo Economicus regarding a concentration as a limit to give (source) or to take (sink) can come to the same result as the outer model; b-c=0 *i.e.* 2.5mM in a symmetric ensemble. Therefore, Homo Economicus acts reasonable and rational. But that is also the starting point for conflicts. Source and/or sink must be forced or deceived to change their reasonable behaviour. Source and sink could have other inner models than the model of a Homo Economicus. Conflicts would be absent if source and sink would have no inner model at all. The possibility of superadditivity and subadditivity would still exist as this depends on the outer model. Whether the source and sink are active or not would then depend on the on the inner model of the master. Whatever inner model source and sink would use to guide their behaviour, conflicts will only arise when the inner model of master and source and sink differ. Inner models can be the cause of subadditivity in source and sink even in the absence of a master because the inner models can misguide source and sink within the outer model, their reality.

In the preceding section I observed two intentions with different complexity: more transfer (increase concentration limit in sink, decrease concentration limit in source) or more superadditive net profit (increase or decrease concentration limit only when net profit will increase). The determination of a net profit is a very challenging task in comparison to the determination of a concentration or a concentration difference. The simplicity or complexity comes from dimensionality of the model, the necessity to obtain the appropriate information (an additional cost) and to behave accordingly.

The transfer space is a three-dimensional model. The inner model of source and sink may range from a single concentration (a point, dimension zero) to a two-dimensional model with the assumption of certain values (b or c). Source and sink are two-dimensional entities. Although source and sink may use such complex models (b-c=0 as limit) they are not necessarily superior to a simple limit like a concentration. In case the cost function or the benefit function come from wrong assumptions the limit will be wrong, too. The model of the master may range from a single target-concentration in source and sink to a three-dimensional model or of even higher dimensionality than the transfer space. A model with higher dimensionality than the transfer space will not help but confuse as it will result in overfitting.

In a past paper (4) I already introduced a master with a complex behaviour and intention. His aim was to maximize superadditivity by avoiding subadditivity. I called him “prudent master”, a designation and behaviour introduced by Adam Smith. In symmetric ensembles the prudent master will not cross the line of strict equivalence or mixing. He has a linear inner model. This is a very adaptive, demanding, and intelligent strategy as he can´t stick to a fixed value of a substrate concentration like a wise limit (4) which is a constant inner model. In figure 8 we observe again a type of a prudent master but now with a nonlinear inner model suitable for an asymmetric ensemble.

Figure 8

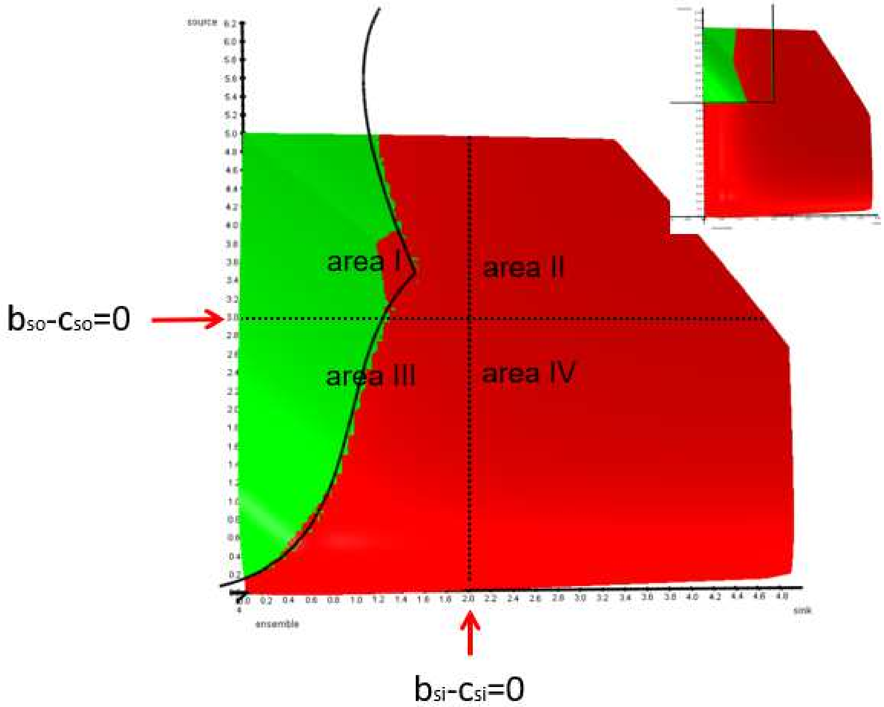

Figure 8

A single weak asymmetric ensemble is shown top down (source to the left, b-c=0 at 3mM; sink at the bottom, b-c=0 at 2mM; net profit of the ensemble towards the observer). After 2000 generations the master has leaned to optimize superadditive net profit with two sinus functions as limits (black lines) of his inner model. Although source and sink have no inner model, the limit b-c=0 is marked in source and sink as this is still a fact in the outer model. Force and deception are therefore not necessary. The small inset is the starting condition at generation time zero. The master will induce giving and taking left of the black line, producing only a small amount of subadditivity in area I and a large amount of superadditivity in area III.

In figure 5 and 6 the superadditive net profit of the ensemble of ensembles with asymmetric weak ensembles was about 1.35np*mM^2 on average of the whole population and could no longer improve. The system was frozen. The superadditive result of a more complex limit discovered by an evolutionary learning process is 7.9np*mM^2 within a single ensemble (figure 8). The starting generation began at the former borders b-c=0 (inset, figure 8). The new border is defined by: a*sin(b*S+c)+d in source and in sink separately. The letters a, b, c, and d are parameters which are changed during the evolutionary learning process. They are mutated with a random, normal distributed value and an expected value of zero and a standard deviation of 0.01. S is the amount of substrate in source and sink of the concentration pair at the limit. The concentration pairs along the diagonal (to the upper left of this pair) will result in a certain amount of superadditivity or subadditivity if the values before and after a transfer are compared. In contrast to the starting conditions (figure 8, inset) subadditivity within the borders is reduced and superadditivity is increased. With a more complex limit (a*sin(b*S+c)+d + e*sin(f*S+g)+h) 7.9np*mM^2 could not be improved further.

In figure 8 it is demonstrated that within an ensemble of a source and a sink without an inner model the master can freely set limits without using force and deception. The complex limits he uses, simultaneously reduces subadditivity and increases superadditivity considerably in comparison to the starting conditions. This time the prudent master will not allow source to give to sink beyond certain values as this will produce subadditivity. The master will reduce the amount already given by source to sink in the starting configuration. The master´s inner model is again shaped by an evolutionary learning process and selection. Every increase or decrease in transfer size will result in an increase or decrease of superadditive net profit. Selection will only reward inner models resulting in an increase of the final balance (superadditivity minus subadditivity). This can be achieved by reduction of subadditivity and by increase of superadditivity.

But imagine you are a two-dimensional entity (source, sink) with your own inner model. You observe how your limits are ignored, violated and unreliably changed when concentrations change and this appears biased towards another party; conflicts will be the result. Source will not accept the reduction of giving as the source rationally gives and tries to get closer to the limit b_{so}-c_{so}=0. Furthermore, also sink will be angry because sink could use this substrate to get closer to its own limit b_{si}-c_{si}=0. This is valid for area I and II. On the other side (area I and area III) the master will increase the amount of substrate taken from source and given to sink. On this side there is still plenty of additional superadditivity. However, this would be against the interest of the source as the source on this side is forced to give beyond the limit b_{so}-c_{so}=0. For many different reasons a rational inner model makes source and sink oppose the prudent master. Prudence would have to be enforced by force and deception (conditional or unconditional) as "prudence" relates to the aim and not to the measures. The prudent master tries to maximize superadditive net profit. Therefore, the prudent master is even able and willing to decrease the transfer size. The master who lives on transfer fees is unable to understand this and unwilling to do so.

The model implies another possible idea of the master. He is capable to decrease area I on one side (area I to area II). That is very helpful in an asymmetric ensemble like figure 3 A, D, G. Here, the decrease in transfer size on one side and the increase in transfer size on the other side will synergistically affect the overall increase in superadditivity (figure 7 and 8). What happens if the master will decrease the size of area I on both sides? In a symmetric ensemble such a behaviour of the master would have a different effect and purpose. Area I with only superadditivity would become smaller; a harm to the ensemble not reaching the full potential of superadditivity. Source and sink must look for another sink or another source to reach b-c=0. This could be the true motivation of the master. The master may be biased towards a new source or sink. He will endure the loss either as a smaller transfer fee or a smaller net profit to share. Later he will then enjoy the better access to net profit share or transfer fees with his favourite source and/or sink. This case has not been investigated.

Connected ensembles - substrate probability:

Until now the different concentrations of substrate in source and sink had the same probability. At a given concentration pair in source and sink a definite net profit and a fixed superadditivity or subadditivity is produced when the net profit before and after a transfer is compared. These point like portions of superadditivity or subadditivity are of different size over the concentration range. Some size classes appear more often than other size classes. A size and frequency distribution of this local portions of super- and subadditivity can be observed; a spectrum. This has not been important before as the ensemble was single or unconnected and only the total amount of superadditivity minus subadditivity was calculated. As soon as connected ensembles (figure 4-3) are observed this is different. Now the top ensemble will receive a spectrum of superadditivity and subadditivity. Only the basic ensembles have an equal substrate distribution over the whole concentration range. This is the only place where substrate enters from the outside with equal probability. Then the substrate is handed over within the ensemble. The decrease in substrate concentration handed to the top ensemble is compensated by a single benefit factor, here bf=6 (2). Now bf has features of a complexity factor. The result is a higher substrate concentration range (again 5mM) for source or sink but now as a spectrum and no longer a uniform distribution with equal probability for all concentration pairs. The production of superadditivity in the top ensemble depends on a high input on the source side and a low input on the sink side. The reverse input may result in subadditivity in the top. This is different when transfer size is the aim. Then the transfer will become large on both sides of the top ensemble. However, the result in the top ensemble depends on what will increase first and in what sequence and size. The observable spectrum in a single symmetric ensemble is depicted in figure 9 and 10.

The spectrum in figure 9 is a two-dimensional representation of a three-dimensional distribution – a repeating cross section. The active part of the transfer space is divided by a 25*25 grid into 625 single columns. The numbering starts at 5mM source, 0mM sink and ends at the actual transfer limit, *e.g.* 2.5mM source, 2.5mM sink in figure 9A or at 0mM source and 5mM sink in figure 9F. The size of superadditivity and subadditivity is displayed on the vertical axis, the position number between 1 to 625 on the horizontal axis. Figure 9A is the starting condition, the ensemble has transferred at free will or with a master in one step to the limit b-c=0 (only superadditivity, 0mM to 2.5mM in source and sink). In 9B to 9F we observe how subadditivity develops and the spectrum of superadditivity changes while the master increases transfers in steps of 0.5mM beyond 2.5mM to finally 5mM. It is easily visible how subadditivity develops below zero. In 9F the ensemble is completely subadditive.

The spectrum of superadditivity and subadditivity handed over to the top ensemble is dependent on the mutational step size (normal distributed) and the location and sequence of the mutational steps (source side or sink side within the same ensemble, in case they are independent like only in figure 8). Therefore, the sequence of differently sized mutational step sizes in source or sink will lead to a unique historical process of the evolution of a connected ensemble. Every specific mutation in step size will result in a different spectrum and in return in a different development of super and subadditivity in the top ensemble. As the Michaelis-Menten equation is not defined in the negative substrate range the subadditivity is set to zero in the connected ensemble in figure 11. In economics this might be different as the subadditivity of a lower level could be felt as a negative income of a higher level. Under real conditions only single concentration pairs will occur per timepoint within one ensemble of ensembles and the result will be handed over to the source or sink side of the top.

Figure 9

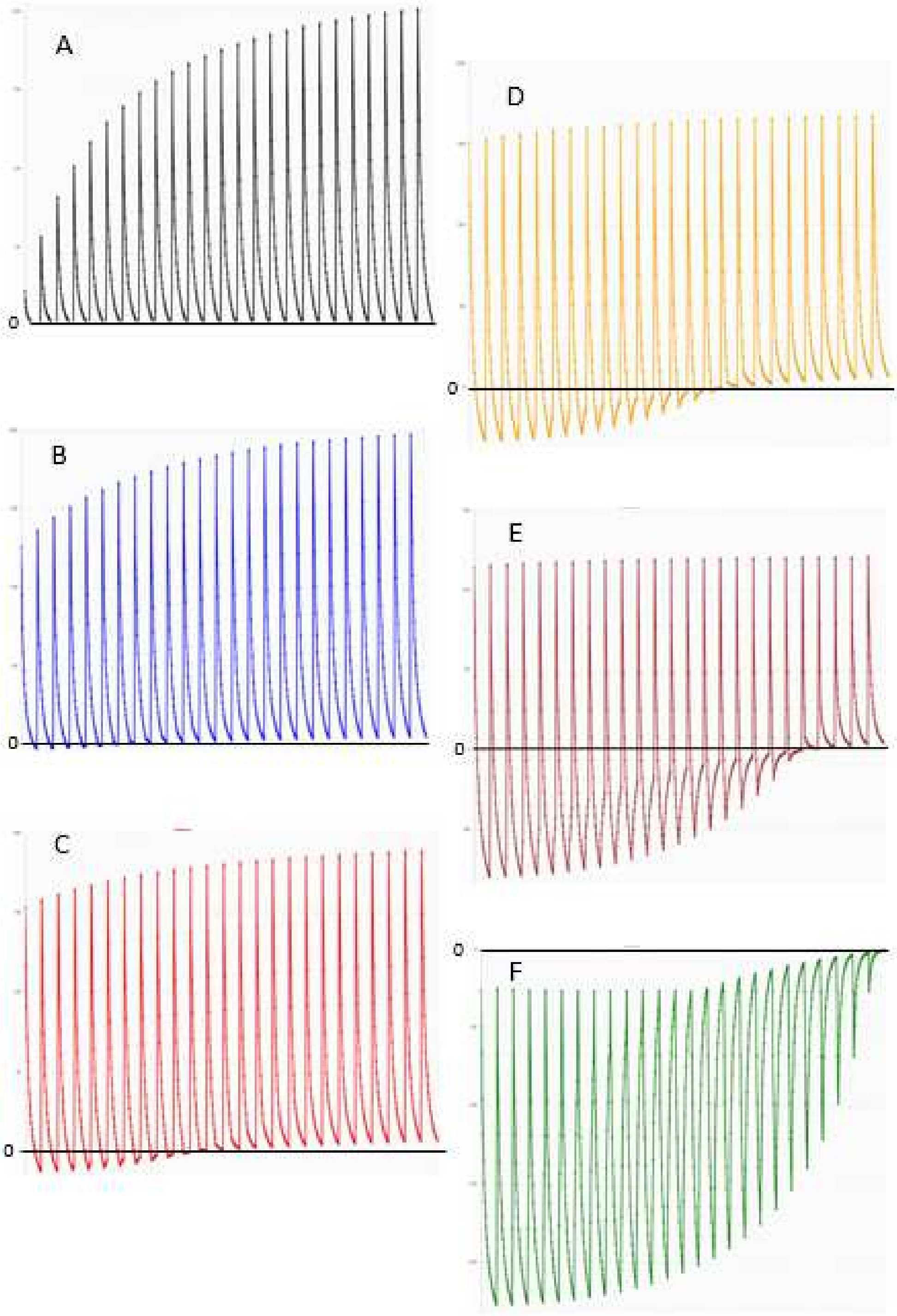

Figure 9

Spectra of a single symmetric ensemble with increasing transfer sizes (A to F). The unconditional violent and deceptive master controls in the beginning (A) a symmetric ensemble with b-c=0 for source and sink at 2.5mM. In B to F the unconditional violent and deceptive master increases the transfers by steps of 0.5mM beyond b-c=0. The complexity factor for super- and subadditivity is 6 although there is no top ensemble. Figure 9A and figure 3B as well as figure 9C and figure 3H are related. X-axis: position number (1-625); y-axis: size of superadditivity (above 0) and subadditivity (below zero).

Figure 10

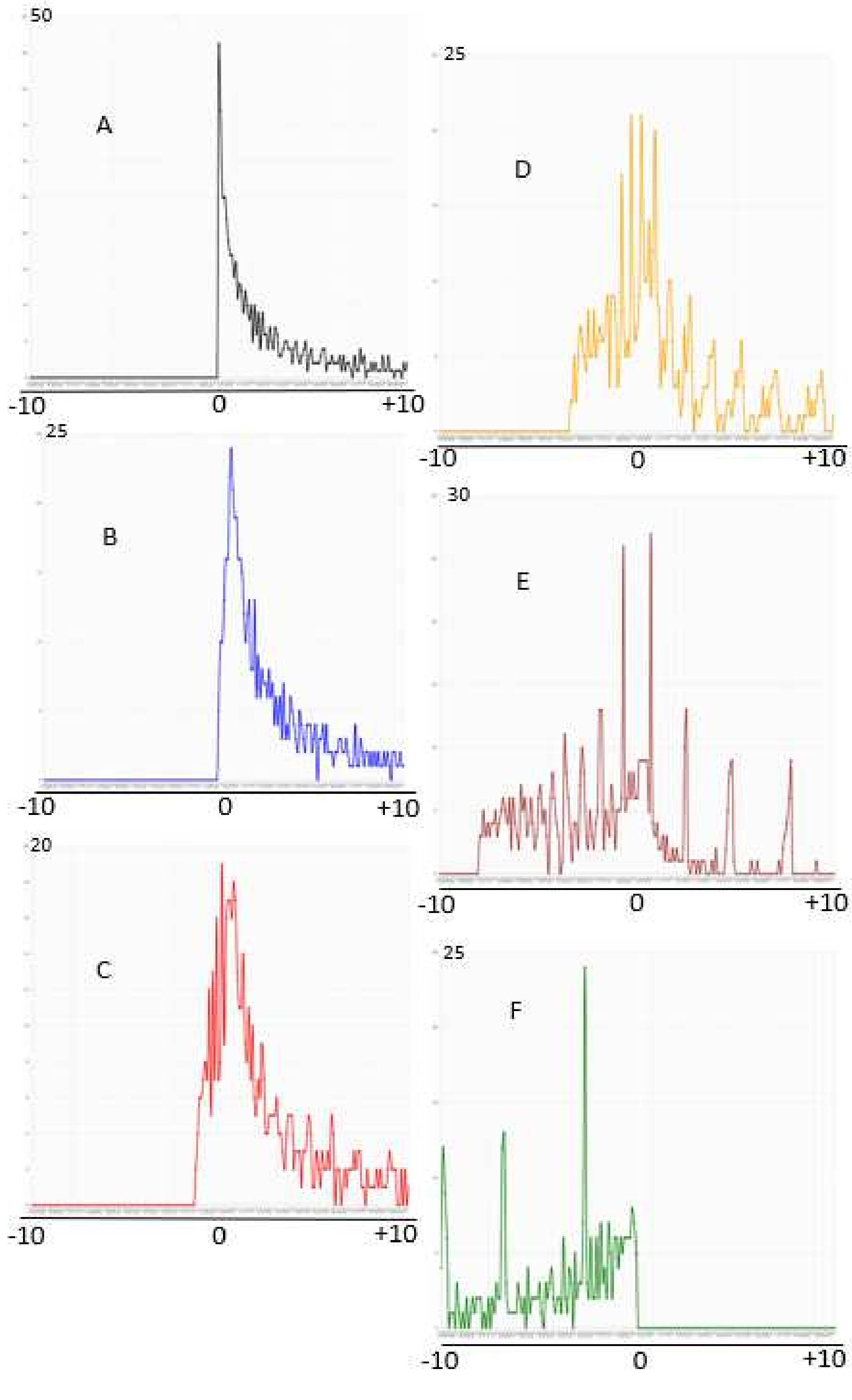

Figure 10

Spectra of a single ensemble with increasing transfer sizes (A to F), size-frequency illustration. The unconditional violent and deceptive master controls a symmetric ensemble with b-c=0 for source and sink at 2.5mM (A). The complexity factor for super- and subadditivity is 6 restoring the range to 5mM. X-axis: size of super additivity (+10) and subadditivity (-10); y-axis, frequency. Figure 9A and figure 3B as well as figure 9C and figure 3H are related. The master increases transfers by force and deception beyond b-c=0 in steps of 0.5mM (B to F). In F the ensemble is completely subadditive.

Connected ensembles – evolutionary behaviour:

Every organism (company) in the following part is composed of three connected ensembles (figure 4-3). The top ensemble will receive a spectrum of substrate concentration from the two lower levels (figure 10). Only the two basic ensembles have equal substrate probabilities in the range of 0mM to 5mM substrate. The benefit factor for the top ensemble (a complexity factor of 6 like in publication 2) compensates for decrease in concentration from the lower level to the top level because Km, Vmax and cf are the same in the basic and top ensemble. Superadditivity can be interpreted here as both, efficiency or additional net profit. The substrate entering the ensembles at the bottom is distributed in a way that there will be better efficiency or additional net profit. Either substrate is left over after superadditive redistribution and is then used in a higher level or additional net profit after redistribution of substrate can be invested in a higher level. The higher level is also understood as a higher level of complexity. This is comparable with the investment of money (glucose) either in workforce (muscles) or computer-controlled automatization (brain). The leverage of the same substrate in the higher level is larger than in the lower level. It should not be forgotten that within the unconnected ensembles three times two substrate portions are consumed while in the connected ensembles only two times two substrate portions are consumed.

A master living on transfer fees (figure 11A, the y axis is transfer in mM) will depend on the transfer size in the ensembles at the bottom where he will enforce transfers by force and deception and will be rewarded for an increase there. The master here is unconditionally violent and deceptive. Besides the increase in transfer in the ensembles at the bottom we are going to observe the production of net profit of the top ensemble. A transfer there by force or deception is absent. A population average of 9 connected ensembles (9*3) and 9 unconditional violent and deceptive masters is observed. According to the transfer size the best three have one offspring each, the next three survive and the last three die. The average (net profit and transfer size) of the population is observed.

A master living on net profit (figure 11B, the y-axis is superadditive net profit – mM^2*np) will participate in the net profit of the top ensemble where no force or deception is used and will be rewarded and observed accordingly. He will use force and deception in the ensembles at the bottom to induce transfers but controlled by net profit in the top. A population average of superadditivity within the top ensemble of 9 connected ensembles (9*3) with 9 unconditional violent and deceptive masters is observed. According to net profit production the best three have one offspring each, the next three survive and the last three die. In parallel the average transfer size within the bottom level ensembles will be observed.

In connected ensembles the two different strategies of masters (10A - live on transfer fees, 11B - live on net profit) reveal very different results. In general, the development of a connected ensemble over the generation time is no longer very reproducible. Every run is unique but reveals a typical behaviour.

In figure 11A the connected ensemble starts superadditive, develops increasing subadditivity which will later reverse but will stay subadditive at the end of transfer. When the transfer arrives at the maximal amount, the system shows only small fluctuations. Locking at three times three connected ensembles (figure 11A, inset), a transitory change (alternating increase and decrease) in superadditivity/subadditivity is observable as long as transfer will go on. At the end of this phase the system is subadditive below its starting value. The fluctuations need transfers.

Figure 11

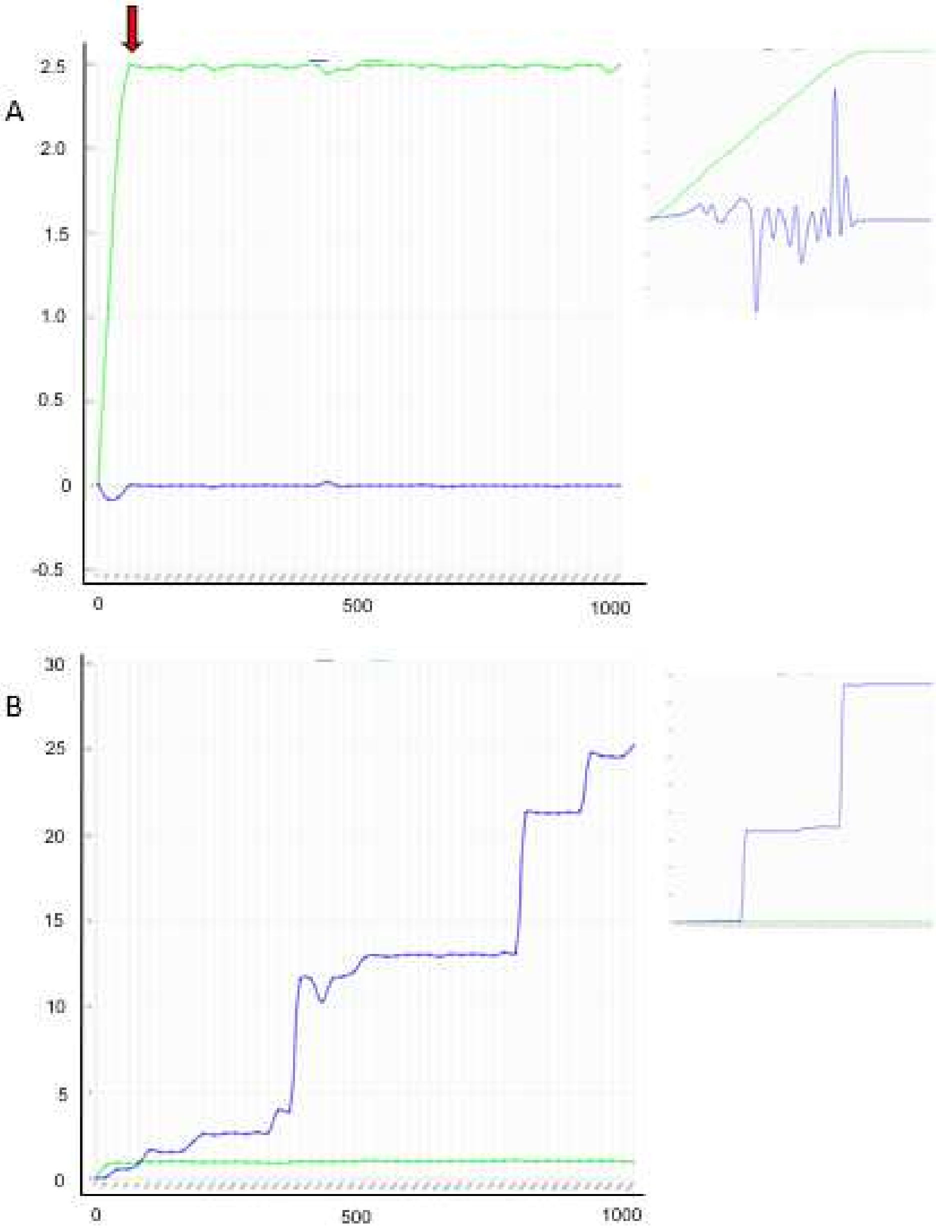

Figure 11

The average transfer size (green, lower levels) and average superadditive net profit (blue, top level) of a population of 9 connected, symmetric ensembles and their unconditional violent and deceptive masters is observed over 1000 generations. A: The masters live on transfer fees in the two lower ensembles. Selection favours larger transfers (green), the limit is set to 2.5mM (red arrow), the maximal possible amount in a symmetric ensemble of my examples. Subadditivity develops in the beginning in this example (blue). This is a single accidental history. Other developments are observed. B: The masters live on net profit coming out of the top ensemble. The superadditivity of the top is observed (blue) as well as the transfer size with force and deception (green) in the lower level. The small insets show the same masters controlling three times three connected ensembles. At the same complexity (range depth one) and at the same maximal transfer size (2.5mM). A more complex history will develop over a longer time but only for the masters living on transfer fees.

In figure 11B transfer does not go far beyond 1mM. The reason is that the master is controlled by net profit. Because of the nature of the spectrum, there is an ongoing improvement of net profit although an increase of transfer in the lower levels is barely detectable. Superadditive peaks on the source side of the top ensemble coming from the basic ensemble are combined with subadditive (set to zero by definition) areas on the sink side. Evolution moves upwards with waiting times (plateaus) from smaller peaks to larger peaks in the vicinity. This leads to a step wise and ongoing increase in superadditivity. This is achieved by minimal changes of the spectrum via minuscule changes in the transfer size on source and sink side. Net profit as bench mark leads again to an internal equilibrium of transfer. This equilibrium is still able to improve!

Other reasons for different substrate probability:

In the past I have always used equal probability for all concentrations (concentration pairs) entering the ensemble from the outside; here in the range from 0 to 5mM in source and sink. This might be viewed as an artificial situation as in nature the concentration of substrate will be probably either high for source and sink or low for source and sink. Substrate will be cost dominated for both sides as there is plenty of substrate or substrate will be benefit dominated for both sides as substrate is scarce.

In figure 12 I look at an illustration of this idea. A single symmetric ensemble has either a substrate concentration higher than 2.5mM for source and sink (area II) or lower than 2.5mM for source and sink (area III). The symmetric ensemble exists either in area II or in area III (for simplicity depicted in the same figure).

Figure 12

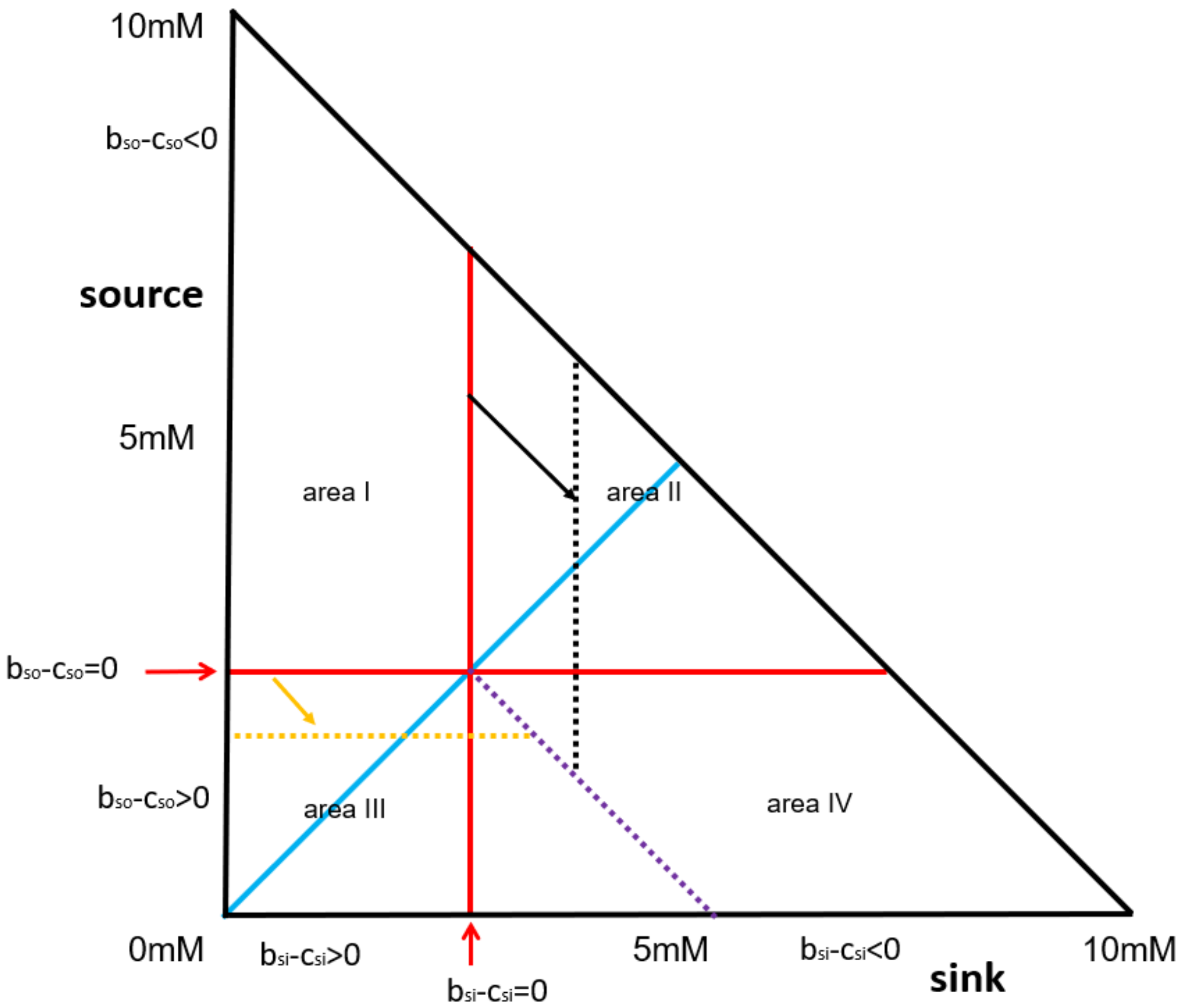

Figure 12

A model of a single symmetric ensemble is shown with the full amount of substrate leading to a maximal total concentration in source and sink together of always maximal 10mM. The red lines (b-c=0 in source and sink at 2.5mM, figure 3B) separate four areas. The light blue line is the line of mixing. Two violent and deceptive masters are compared within the same transfer space. In addition, the masters are not prudent. Conditional or unconditional types can no longer be discriminated. They control either an ensemble with high substrate concentration above 2.5mM (area II) or an ensemble with low substrate concentration below 2.5mM (area III). They increase by force and deception the transfers (black and orange arrows) to new limits (black and orange dotted lines). The purple dotted line indicates the concentration border in area IV to which the concentration will rise in sink (orange dotted line) or fall in source (black dotted line) as a master does not respect any red limit. In case there would be no master and source would force sink to take or sink would force source to give the orange and black dotted lines would end at the red limit b-c=0. The system would not enter area IV.

In previous examinations I always compared masters in control of the whole transfer space. This is different here. Due to the non-uniform substrate distribution the master only controls a part of the transfer space. He is either in control of a saturated ensemble in area II or a hungry ensemble in area III. If I want to compare such masters, I must take care for equal starting conditions. Why are the starting conditions unequal? At a concentration of 5mM in source and 0mM in sink the transfer space contains a certain amount of substrate. At 5mM in source and 5mM in sink the ensemble contains the double amount of substrate in identical volumes for source and sink. Equal conditions are present when always the same amount of substrate is present within the whole ensemble. This is the case in my example at a concentration of 10mM in source plus sink (figure 12). Now I can compare the two masters.

The concentration range is now triangular shaped. Even in a symmetric ensemble the four areas are no longer of identical size and shape. However, there is now a just access to the same maximal amount in source and sink.

In case source and sink have no inner model, the master will steer them without problems. In case source and sink are two Homo Economicus the master must force them to give (source, area III) or to take (sink, area II). Force and deception start at b-c=0 (border between area I and II or border between area I and III). The cost of force and counter force is omitted. Now I am going to compare two masters who rule either an ensemble with abundance (area II) or deficiency (area III). The masters are no prudent masters. Starting at b-c=0 they learn that more substrate can be transferred, and more net profit can be made by force and deception. We observe the balance of super- and subadditivity. It is here no longer possible to differentiate the unconditional violent and deceptive master from the conditional type. The basic superadditivity of area I is absent.

Figure 13

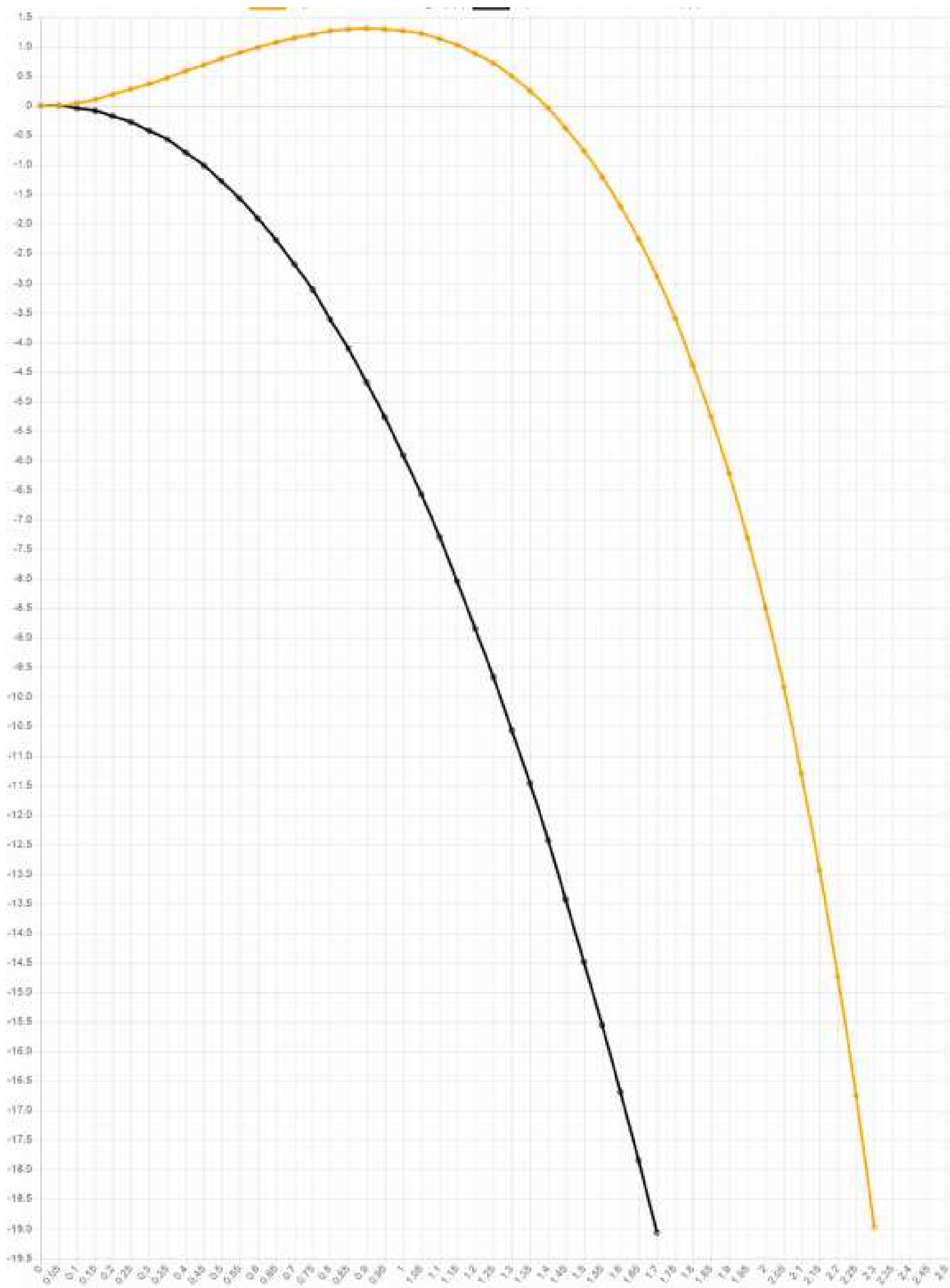

Figure 13

A single weak asymmetric ensemble is depicted (b-c=0 at 3mM in source, 2mM in sink). We observe the superadditive/subadditive net profit (y-axis) of two masters in control of an ensemble either with lack of substrate (area II, orange) or with surplus of substrate (area III, black). The increment from b-c=0 into area II or area III is systematically variated by a step size of 0.05mM (x-axis). The black and orange curve will intersect far into subadditivity at a very high transfer size.

Figure 14

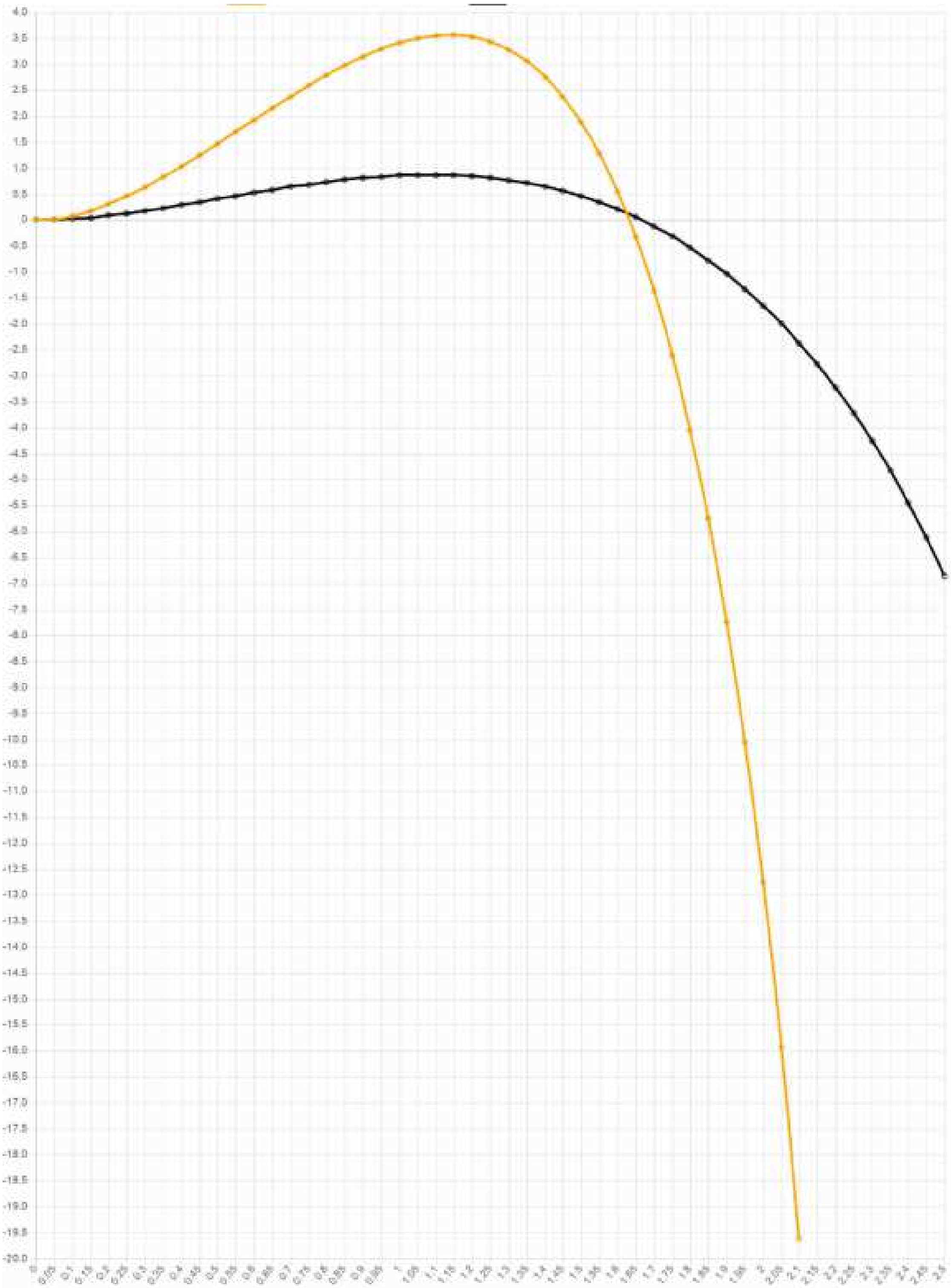

Figure 14

A single symmetric ensemble (figure 12) is depicted (b-c=0 at 2.5mM in source, 2.5mM in sink). We observe the superadditive/subadditive net profit (y-axis) of two masters in control of an ensemble either with lack of substrate (area II, orange) or with surplus of substrate (area III, black). The increment from b-c=0 into area II or area III is systematically variated by a step size of 0.05mM (x-axis). The black and orange curve intersect at a small superadditive value and an intermediate transfer size.

Figure 15

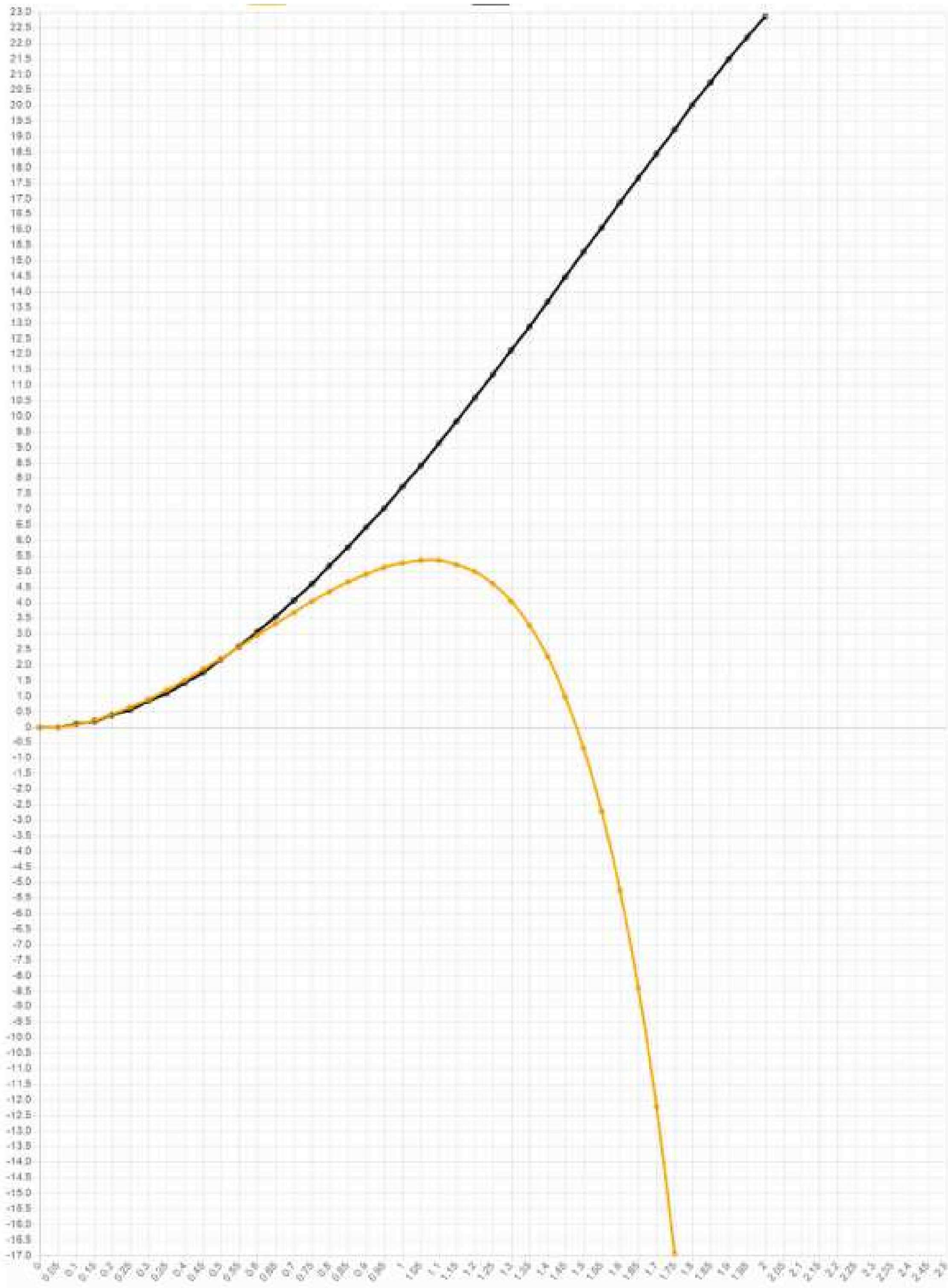

Figure 15

A single strong asymmetric ensemble is depicted (b-c=0 at 2mM in source, 3mM in sink). We observe the superadditive/subadditive net profit (y-axis) of two masters in control of an ensemble either with lack of substrate (area II, orange) or with surplus of substrate (area III, black). The increment from b-c=0 into area II or area III is systematically variated by a step size of 0.05mM (x-axis). The black and orange curve intersect at a superadditive value and at low transfer size.

In figure 13 to 15 we compare two masters using force and deception. They live under two different conditions *i.e.* lack in area III and surplus in area II. In addition, we lock at three different types of ensembles, two asymmetric ensembles and one symmetric ensemble. The transfer size is limited to maximal 2.5mmol in steps of 0.05mmol beyond b-c=0. The limit b-c=0 differs within the three figures (figure 13, 14, 15)!

In a weak asymmetric ensemble (figure 13) the master who is in control of the ensemble which has to deal with a lack of substrate is always doing better. This is only true for the observable part of the subadditive range. In the symmetric ensemble (figure 14) the master in control of the ensemble with lack of substrate is in the beginning doing better. Later, when subadditivity starts to develop in both ensembles, the master with an ensemble active with surplus of substrate is doing better as subadditivity does not develop so dramatic. Interestingly there is a transfer size (1.65mmol) where the ensemble with surplus of substrate is still superadditive while the ensemble with lack of substrate is already subadditive. Finally, in an asymmetric ensemble with a strong sink (figure 15) it is interesting to observe that in the beginning the ensemble with surplus is doing still slightly worse than the ensemble with lack of substrate. However, later in the observed transfer range (2.5mmol) the master with the ensemble in surplus will dominate with superadditivity while the master and his ensemble with lack of substrate will be completely subadditive.

General Discussion

The roots of the idea

The idea of a complete balance within the transfer space of a source and a sink goes back to Antoine-Laurent de Lavoisier (born 26.08.1743 – executed 08.05.1794), economist and chemist. He is acknowledged as one of the fathers of modern chemistry. He changed chemistry from a qualitative to a quantitative science by introducing the mass balance. As administrator of the "Ferme Générale", a tax farming company in the pre-revolutionary France, he was used to the concept of a balance sheet. In his experiments *e.g.* with mercury(II) oxide (HgO) he understood that he not only had to observe the weight of the vessel where mercury(II) oxide would decompose to mercury upon heating but he also had to control the weight of "the other vessel" - the surroundings - to make a complete balance. He collected the developing gas (oxygen) and found that the mass of the starting material (mercury(II) oxide) was identical to the sum of the mass of the products (mercury and oxygen).

The same is simply repeated here again. We do not only have to observe what happens in one enzyme-filled vessel (cell, organism, company or country) when we put substrate in; we also must observe the vessel where this amount of substrate came from. For simplicity this vessel should be as identical as possible. A complete balance should include both vessels connected with each other as source and sink. The mass (and energy) is conserved during the transfer. The productivity after a transfer from source to sink with its non-linear, saturating behaviour will show us new features (superadditivity and subadditivity) in comparison to the condition "no transfer".

This may appear to some readers like the parable of the broken window ("*That Which is Seen, and That Which is Not Seen*" by Frédéric Bastiat).

But my model is not about a microeconomic opportunity cost. It is not about "here or there" in one party. The paper is about "before a transfer and after a transfer" within an ensemble of the same two parties; a source and a sink.

Quantity and Quality

A function in mathematics is the model of how a quantity depends on the variation of another quantity; $y=f(x)$. In the physical world we often face the fact that a quantity depends not only on a single other quantity but usually on many others with different functions; $y=f_1(x_1)+f_2(x_2)+\ldots+f_n(x_n)$. Solid experiments try to control complex dependencies either with the skilful exclusion of such effects or by control experiments.

A second possibility is that a single quantity (x_1) may have different features (functions); $y=f_1(x_1)+f_2(x_1)+\ldots+f_n(x_1)$. Here it is not possible to reduce the experiment to one single dependency. We may observe in controls a first function with a positive influence and a second function with a negative influence on the outcome; y. Therefore, we sometimes observe an unexpected change (*"Nach fest kommt ab." - Don´t push too hard.*) while we change the quantity *e.g.* a linear force increase.

Experience is teaching that "*more is not better*" or that there is the possibility of "*too much of a good thing*". This is often discussed as a problem of quantity versus quality. But what if quality is a combination of two independent features connected and related by a common quantity? Quality emerges from the relative share of the two different features. In case the quantitative nature of a first feature is obvious and easily determined and the quantity of the second feature is difficult to determine, then this may appear to us like the quality dimension. In the case of genetic entanglement (7) the kin and its fate for the balance of all identical genes appears as a quality in comparison to the self as a quantity and as an orthogonal dimension. The “two times two” features (b, c) in entanglement (ef, degree of informational identity) are connected by a single substrate and the two pairs of benefit and cost are orthogonal as are source and sink, *i.e.* parent and offspring. The effect of the success factor (sf, an external factor indicating the probability of survival) in entangled, symmetric parties is asymmetry. In reverse, the success factor can compensate for asymmetries in Km, Vmax, cost factor and benefit factor.

How can we judge where we are in “quality” (*good – too much good*) when we measure only a single feature of the quantity (*thing*)? – Not at all! We must determine both aspects (features) of that quantity.

“Too much of a good thing” implies the presence of an optimum or at least a change of character. “Much” will be good - better than little - but “too much” will be no longer as good. There are many functions producing optima or go from positive values to negative values. I create such behaviours with two monotonously rising functions both dependent on the quantity x_1.

Let there be two features of the quantity - *e.g.* a substrate. The two features of the substrate (x_1) are a benefit with the function (f_1) and a cost with the function (f_2); $f_1(x_1)$ and $f_2(x_1)$. When we increase the amount of the substrate the two features independently and monotonously rise and follow their respective functions. In case they intersect we will see on one side of the intersection values of function f_1 dominate over values of f_2 and on the other side we will see values of function f_2 dominate over values of f_1 (change of character). When we look at each single function (feature) we will always see an improvement. But the improvements stand in opposition to each other. When the features are measurable in the same physical dimension we can subtract the values ($y=f_1(x_1)-f_2(x_1)$), in case they are measured in different physical dimensions we divide them ($y=f_1(x_1)/f_2(x_1)$). The intersection in subtraction will be zero and in division one. Depending on the sequence (f_1,f_2 or f_2,f_1) and the shape of the functions we may observe a maximum or a minimum somewhere.

Why is net-profit such an important concept?

In the investigated evolutionary learning process two types of evolutionary ratings are examined. On one side I use a positive relation between success and amount; "more transfer is better". In the alternative rating I use a positive relation between success and superadditive net profit; "more superadditive net profit is better" which is basically more net profit in a wide range of concentrations. It is generally acknowledged that net profit is the most important and most used criterion to judge whether a company is successful or not. The same could be said about organisms when we compare *e.g.* the consumption of energy (glucose consumption as cost c) of a hunting predator and the gain of energy equivalents (protein and fat of the prey as benefit b).

Why is net profit such an important measure? I think it would be too simple to argue from a quasi-evolutionary standpoint like: "Other criteria to judge the success in economics and in biology have not proven to be as effective as the use of the concept net profit". This is not an explanation, this is only an observation. Why do we make this observation?

From my results it seems that we reach independently of what we observe (amount transferred or superadditive net profit) only with superadditive net profit as selection criterion stability. Turnover as criterion will always go to extreme values and leaves the range either at positive (transfer size) or negative (net profit) values. With net profit as criterion the ensemble will find an internal point of stability. The external limits of the ensemble are not exceeded. Transfer size as criterion will always exhaust the capacity of the ensemble and blow up the limits. Wise limits may be violated by both criteria.

In connected ensembles there are additional observations. The increase in net profit takes place in steps. Source and sink at the bottom should go different directions. The ensemble on the source side should deliver much superadditivity, the ensemble on the sink side should deliver only a little superadditivity or deliver subadditivity. Most amazing is the effect of the spectrum of the super- and subadditivity in masters living on transfer fees. While there is increasing transfer there will be "something to observe". If such a master is going to observe the net profit - which is basically not his personal interest - he will be very surprised. An increase in transfer may increase superadditivity and in the next step of increase it will produce subadditivity.

"Certain forms of knowledge and control require a narrowing of vision" (8). This narrowing of vision is the starting point for a master to fail. What appears useful under a certain condition may be complete nonsense in the direct adjacent condition. Linear minds only succeed to extract simple patterns from complex, nonlinear patterns. Those simple patterns produce easy to understand, convincing models but they fail the test of reality – repeatedly. The reason for the repetition of mistakes is the lack of insight into cause and effect and the lack of a sense of personal responsibility and the experience of personal suffering in distant advocates.

Culture, Religion and political Ideology

A Greek proverb says: *"A society grows great when old men plant trees whose shade they know they shall never sit in."* Culture seems to be an integrated system of force and especially deception in man to create superadditivity outside of area I. However, this will include irrational, self-harming economic behaviour on the level of the single party.

Two advances are immediately obvious:

- additional superadditivity of the ensemble when the limits are carefully chosen and the additional costs are controlled;
- the ensemble can be active when substrate is benefit dominated for source and sink (area III) or cost dominated for source and sink (area II) simultaneously (figure 12 – figure 15). An ensemble of rational entities (two Homo Economicus, strong and informed) would be inactive under such conditions.

It seems to be a very probable situation that the substrate distribution is for source and sink similar; either both lack substrate dominated by benefit (b-c>0) or both have a surplus of substrate dominated by cost (b-c<0).

Religion and ideology are deceptive concepts to induce transfers beyond the rational limit b-c=0, outside of area I. The specific deception will convince someone to take a cost dominated substrate or to give a benefit dominated substrate without expensive and harming force. This will only work if benefit and cost - the inseparable connected features of the substrate - are separated within the ideological framework. Even in science there are attempts to construct a world where benefit and cost are separated (9, 10) and net profit is no benchmark. The basic assumption in all this scientific teaching is the existence of a phlogiston-like concept called "altruism". It could well be that the twisted complexity of game theory in biology is based on an ideologically and religiously founded emotional rejection of the rational and self-limiting net profit. Phlogiston-like constructs and miracles always vanish when a complete balance is implemented.

The ability of an ensemble to find a rational and sustainable internal limit using net profit as benchmark is a danger to an external instance (master) living not on increased net profit of the ensemble but on transfer fees. Therefore, this type of master hates the idea of net profit. His teaching, the whole culture he will create, will praise emotions and irrational behaviours of role models and deter and discredit rational behaviour. He will either avoid scientific proof and claim higher values and believes to discourage and break resistance or scientific proof is claimed although the scientific method is not followed as the predicted progress reveals as an endless failure. This type of master is interested to increase the size and amount of transfers. The ensemble, dependent on its internal superadditivity, is doomed as the unlimited and irrational transfer will increase subadditivity until all superadditivity is consumed. The master with his ideology moves on as archenemy of the free man (Homo Economicus) and ensembles formed by him. Homo Economicus – as an ideal strong and informed – will never fall prey to force and deception thus avoiding area II, area III, and especially area IV of the transfer space. His freedom of decision to stay away from areas II, III, and IV comes at a price. Such ensembles can´t be active outside of area I. This inactivity is a strategic weakness and comes from strength and knowledge; what an irony, what a tragedy.

But maybe that is the difference between humans and animals. The inner model of animals shaped by evolution may be very identical to reality (the outer model). Therefore, animals behave like a Homo Economicus. This realistic inner model, this genetic *a priori* knowledge, is at least partially lost in humans. Humans can be educated and deceived to follow new inner models and therefore can be active outside of area I. Outside of area I superadditivity is produced by harm to at least one party. This is rewarding to the master and maybe to the ensemble they are a part of as long as superadditivity dominates. To compensate the harm reciprocity or a constant natural overproduction is necessary. Replacement of burned parties by a new generation will stabilize the ensemble and prevent a Nash equilibrium. It should not be forgotten that the balance we observe is made within a steady state equilibrium of a biological system constantly powered by the sun; this is not a closed system. Although we observe in Biology and Economy an open system mass and energy will be conserved in its very basic meaning – nothing comes from nothing and nothing vanishes into nothing. A complete balance will always show this.

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