

Re: OOL I – Manifesto and metatheory

Source: <http://sci.tech–archive.net/Archive/sci.bio.evolution/2005–04/msg00441.html>

- *From:* rem642b@xxxxxxxxxx (Robert Maas, see <http://tinyurl.com/uh3t>)
 - *Date:* Thu, 21 Apr 2005 00:27:03 –0400 (EDT)
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> From: "Perplexed in Peoria" <jimmenegay@xxxxxxxxxxxxxx>
> All that is required for kin selection to operate is that the actor
> must socially interact with relatives more frequently than he does
> with the general (breeding and competitive) population.

Yes, but that can't be obtained unless the kin–altruistic individual can somehow either discriminate kin from enemy or happen to be in an environment where most nearby individual are kin so helping anyone nearby is good enough discrimination. Note that assuming anyone nearby is kin can be swamped by alien squatters, so a strategy based on that assumption might not be stable. I'm quite sure that freefloating chemical replicators are unable to achieve **any** way of interacting only or predominately with kin.

Furthermore, whereas kin altruism in animals involves direct interaction, kin altruism in simple chemical replicators would usually involve interacting with some **other** chemical which indirectly benefits the kin. So your criterion wouldn't be valid. For example, an altruistic replicator within a micro–ecosystem might attack invading chemicals to protect other replicators of the same micro–ecosystem, or might produce food that other replicators eat, or might produce lipids or DNA strands to enlarge or strengthen the cell membrane to better protect other replicators within it. I see no way, except group selection within a micro–ecosystem, that simple chemical replicators would have selection pressure to develop any kind of altruism.

>> (2) Tit–for–tat game theory, whereby individuals keep track of who is
>> being nice and who is being nasty, and cooperate only with others who
>> have been nice. This doesn't work unless individuals can recognize
>> specific others and distinguish them and keep track of which have been
>> nice and which haven't.
> Which doesn't necessarily require nervous systems. Plants, for
> example, could conceivably play tit–for–tat with other nearby plants.

I agree. Given inability to move around quickly, longterm connections between nearby plants could be established, whereby all communication along a given connection is virtually assured of being with the same <other> as it was all previous times, hence tit–for–tat can be played along each such connection (communication channel). And such

Re: OOL I – Manifesto and metatheory

tit-for-tat can be done by simple chemical methods performed locally, not requiring any communication with other parts of the plant.

- > If the sending of trustworthy signals is classified as "cooperation",
- > then there are certainly ways of having an ESS that don't fit into
- > the above three.

If there is a cost imposed to the altruistic sender, and benefit only to the passive receiver, then what other mechanism would somehow reward the sender for making that expenditure? With group selection, the sender prevents the whole micro-ecosystem from dying, hence achieving benefit eventually. With kin selection, copies benefit. With tit-for-tat, there is direct benefit during the next iteration of the game. What other delayed-reward system do you claim could exist? Please tell!

- > I said nothing about tit-for-tat, nothing about cooperation, and, in
- > fact nothing about communication at all other than the fact that
- > group selection is not necessary to explain it.

And I said I know of only three ways (groupSel, kinSel, titForTat) that allow cooperation/altruism (*) to be an ESS, and you seem to say there's yet another, and I'd like to know what you have in mind.

* ("cooperation" in the usual English sense requires both parties to "cooperate" in the tit-for-tat single-action sense. It's that latter sense that I am talking about here. Why should an organism be nice by cooperating unless there's some mechanism for rewarding it for the expense it incurred by being nice?)

(Above composed Tuesday, below started Wednesday.)

- > However, since you raise the subject, let me say that I think that
- > reciprocity (of which tit-for-tat is one model) is probably of
- > central importance in any OOL scenario in which there is symbiosis
- > (leading to union) between two species of replicators.

Carefully distinguishing this kind of repeated-interaction game-theoretic reciprocity from group selection of trapped-together co-evolving replicators, I don't think the kinds of simple molecules we're proposing as first just-barely-life, nor for quite a while down the evolutionary road from there, can possibly engage in any form of game-theoretic reciprocity whereby they are nice to neighbors only if those specific neighbors have been nice to them already/currently. Even plant-like being nice to long stable touching-partners can't work with simple chemical replicators. They're orders of magnitude too simple to be capable of such learned behaviour.

- > 1. Weak mutualism (or ecological mutualism) is a relationship between
- > species. For example, plants provide food to animals, who then return
- > CO₂ to the atmosphere and nitrogen to the soil, thus benefiting plants.

Re: OOL I – Manifesto and metatheory

- > Cycles of this sort are of little evolutionary significance because no
- > individual plant or animal organism has much incentive to hold up his
- > end of the bargain.

This isn't keeping your end of the bargain. This is dumping your waste into the environment with total disregard to what life may be harmed or killed by your toxic waste, and some other species learning how to detoxify your waste and in some cases making profit from it. Most life either is killed by even slight amounts of oxygen, hence needs to hide from it deep under mud or rock, or needs to spend valuable energy detoxifying it. From a cladistic viewpoint, only a small portion of life can actually make use of oxygen. Yet the clade that does photosynthesis with water as the hydrogen donor keeps dumping this oxygen into the atmosphere without regard to the harm it does to the majority of the clades.

Even the example you cite, of plants generally providing food to animals (ignoring the specific cases where plants recruit animals to carry seeds through their guts or on their fur), and animals&fungi usually providing CO₂ and inorganics useful to plants, is just another example of dumping waste without regard to whether it helps or harms others, without any sort of 'bargain' involved.

- > 2. Strong mutualism (or 1–1 mutualism) involves an exchange of
- > benefits between individuals (presumably of different species). A
- > flowering plant provides nectar to the bee, and the bee reciprocates
- > by transporting pollen. The reciprocity of the transaction is almost
- > automatic – neither bee nor plant has any need to remember individuals
- > of the other species.

The memory is done at the genomic level, with the disadvantage that the learning process takes millions of years, but taking advantage of the fact that the enemy's adaption process also takes millions of years. If the insect species evolves a way to cheat by taking nectar without delivering pollen, then those plants which are most vulnerable to this form of cheating decline in numbers, while those plants that by chance have a way to refuse giving nectar to all those insects, or even better a way to tell the difference between cheaters and non-cheaters and give nectar only to the non-cheaters, increase in numbers. One round of the tit-for-tat game consists of one multi-million-year evolutionary period during which a counter-strategy can evolve. A cheater can achieve an advantage for only one game round, then gets punished during the next game round, just like prisoner's dilemma game but with a much longer time per round.

At evolutionary time scales, there is no such thing as an individual organism, nor even individual genome, there are only clusters of genomes that form species. Genomes really do recognize other (clusters of) genomes and cooperate or non-cooperate with them selectively per tit-for-tat strategy, in the sense of having genes that produce phenotype characters which cooperate with phenotype characters of

Re: OOL I – Manifesto and metatheory

non-cheater genomes but which refuse to cooperate with phenotype characters of cheater genomes.

- > However, if the species can remember each other, then there is the
- > possibility of deferred strong mutualism (tit-for-tat) in which the
- > reciprocity is not automatic.

What you wrote there was a bit vague. Did you have anything particular in mind when you wrote it? Would you consider my previous paragraph, about evolutionary-timescale tit-for-tat, as what could have been meant by what you wrote just above here. Would you agree that whenever a species "remembers" another species, it's probably either the kind of evolutionary-timescale "learned behaviour" that I described above, which couldn't occur during the very early stages of OOL, or the normal kind of learned behaviour that can occur only in a sufficiently intelligent creature far beyond what we had during any of OOL whatsoever nor even in most present life?

As an example of true learned behaviour, imagine a chimpanzee which tastes various kinds of fruit, finds some are so bitter they have to be spit out, some don't taste too bad but make the chimp sick, so the chimp learns to avoid not just those individual plants with that fruit but *all* other plants that look similar (most of which are of the same species), and perhaps communicates such knowledge with other members of his/her social group. However this is an individual, or a social group that shares wisdom, learning about other species, not the species per se learning about other species. By comparison, the evolutionary-timescale "learned behaviour", due to mixing of genes despite geographic barriers over such long timescales, truly is a whole species learning about other species.

- > Note that I said that the reciprocity is "almost" automatic.
- > Cheating IS possible – a flower could provide pollen, but no nectar,
- > or a mutant bee could have teflon-coated hairs on the legs that do
- > not transport pollen.

Oops, I already read this before getting the inspiration to write about evolutionary-timescale tit-for-tat "learned behaviour" above. I just want to add here that if a species does not have the evolutionary capability to evolve a defense to cheating, it'll be so vulnerable to such cheating, and cheaters will be unpunished for so very many rounds of the game, that cheating will become quite profitable, and probably drive the victim species to extinction. Nowadays I would expect that all species are capable of evolving defense to cheaters.

- > Models of this situation are VERY complex, involving Zahavi processes
- > (*) as well as the possibility of group-selective and kin-selective
- > mechanisms.

I never heard of "Zahavi processes", so I tried to do a Google search, but searching for both words produced what looked like all false

Re: OOL I – Manifesto and metatheory

matches, unless the matches referring to "Zahavi's handicap principle" were relevant, let me know and I'll look closer, while searching for either "Zahavi processes" or "Zahavi process" with quotes to group the terms produce no hits whatsoever.

I don't see how group selection can be useful for this process except in tightly-knit social groups among intelligent animals, or in co-evolving trapped genomic units trapped together in micro-ecosystems, except in that case the very early stages of OOL wouldn't yet have sufficient genomic control over phenotype to be able to develop such complex adaptions. I see the development of altruism within such a micro-ecosystem, such that eventually it qualifies a fullfledged "organism" of cooperative parts instead of just an ecosystem of independent parts, as occurring prior to any evolution of such organism to recognize/distinguish friend/foe among other organisms. So I don't see any of these cases relevant for OOL theories.

- > 3. Iron-clad mutualism is strong mutualism without the possibility of
- > cheating by either party. This (impossibility of cheating) might arise
- > in one of two ways:
- > a. There are no cheating variants because there are no variants – no
- > mutations. Many models of primitive replicators (including yours
- > IIRC) make heritable variation in the replicator almost impossible.

But there's no reason such a mutualism would pop out by pure chance. Without any evolutionary mechanism to produce it, and with no variation there's no mutation hence no evolution, QED.

- > b. Cheating is physically impossible. A "fair" exchange of benefits
- > must take place or there is no exchange at all. For example, the
- > host interacts with symbiotic mitochondria by exchange of material
- > through port-antiport mechanisms. ...

This is irrelevant to OOL because such complex biochemical pathways and exchange mechanisms didn't evolve until a long time after OOL.

- > Iron-clad mutualism between two autocatalytic cycles could take place
- > if the two exchange materials at an intersection between the two
- > cycles.

I see no reason to expect such a situation would arise by chance even once on any given planet, although given a gazillion different planets all doing OOL independently it's reasonable that one or two planets here and there at random might chance on such a situation, and no mechanism to evolve toward it during the non-evolving just-barely-life stage of OOL.

- > An ecological mutualism between two cycles, in which the waste
- > products of one are released to the "soup", from which they are
- > extracted as food by the second (which then releases wastes, etc.) –
- > such ecological mutualism is IMO without evolutionary significance

> for OOL.

Except in the sense that the existence of a large bulk of "waste" from one replicator might make it more likely for a second replicator to form, specifically a new replicator that happens to use that very-non-Geilstein "waste" as part of its food, agree?

> For OOL, we need iron-clad mutualism, or else we should forego the
> symbiotic union model all together, and start with a quasi-cellular
> organism.

The only kind of mutualism I see likely in semi-early OOL is when replicators get trapped together and undergo group selection whereby inner-cooperating micro-ecosystems survive better than infighting micro-ecosystems, causing the quantity of inner-cooperation to increase over time among the surviving micro-ecosystems. I see no mutualism greater than chance/fluke to appear prior to the appearance of trapped-together replicators, i.e. no selection pressure toward increased (above chance/fluke levels) mutualism until group-selection of replicators within micro-ecosystems appears, and then *only* inner-mutualism at that time. Agree or disagree?

• ***Follow-Ups:***

- ◆ ***Re: OOL I – Manifesto and metatheory***
◇ From: Perplexed in Peoria
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• ***References:***

- ◆ ***Re: OOL I – Manifesto and metatheory***
◇ From: tinyurl.com/uh3t
- ◆ ***Re: OOL I – Manifesto and metatheory***
◇ From: Tim Tyler
- ◆ ***Re: OOL I – Manifesto and metatheory***
◇ From: Robert Maas, see <http://tinyurl.com/uh3t>
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- Prev by Date: ***Re: Heritable Trait – ear lobe phenotype***
- Next by Date: ***Re: OOL X – The origin of the RNA world.***
- Previous by thread: ***Re: OOL I – Manifesto and metatheory***
- Next by thread: ***Re: OOL I – Manifesto and metatheory***
- Index(es):

Re: OOL I – Manifesto and metatheory

- ◆ Date
- ◆ Thread