# CO-OPERATION AND COMMUNICATION IN APES AND HUMANS

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**Abstract**: Our aim is to elucidate the similarities and differences between humans and apes as concerns co-operative behaviour and its relation to communication. In particular, we will point to the decisive role of symbolic communication for making more advanced forms of co-operation possible. We distinguish between competitive and collaborative co-operation and take this distinction as a starting point for our analysis. In competitive contexts, co-operation is triggered by what is present in the environment. The resource that is competed for is available and accessible, but not yet in possession. Humans, but not apes, can as well engage in collaborative co-operation. In this type of co-operation the resource is not manifest, but mainly imagined. The reason why only humans can co-operate collaboratively is that they can imagine what is not there. We submit that language has evolved as a tool by which humans can make their imaginations known to each other, in order to enhance co-operation. Language gives human beings a great advantage as concerns co-operative behaviour, especially regarding communication about goals and the ways to reach them. Symbolic communication makes use of representations as stand-ins for actual entities. Use of representations thus replaces the use of environmental features in communication. A consequence of this is that language makes it possible to jointly attend to imagined goals. Joint attention is a more basic capacity than language-use. It is necessary for all kinds of co-operation because it makes it possible for different subjects to attend to a common goal. Apes can engage in joint attention, but do not achieve the same complexity as humans. They can jointly attend only to things that are present in the context. This makes it difficult to co-operate in order to achieve a goal that is not present in or implicated by the immediate environment. Another difference between humans and apes is that apes cannot represent the goal without the means to reach them. Humans, to the contrary, can reflect about different ways of reaching the goal. To be reached, the same goal may require different means in different contexts. Likewise, the same means may afford different goals in different contexts. Intentionality emerges as an ability to adopt the means to the situation at hand. Intentional behaviour is flexible. It depends on the agentís ability to appreciate the distinctive character of each context it encounters. It also depends on the agent's ability to learn about new contexts and how to deal with them. An application of our analysis of different kinds of co-operation is game theory. Co-operative and non-co-operative games, as considered in the traditional theory, are in our opion only the extremes of the possible levels of co-operation. By taking into account different levels of joint attention and communication, a more fine-grained analysis of co-operation in game theory is possible. In particular, the availability of symbolic communication can change a strategic situation that is of a prisoner's dilemma type into a fully co-operative situation.

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## CO-OPERATION

Both human beings and animals co-operate in order to reach common goals. There are many ways of co-operating. Some of these ways may not merit being called co-operation in the literal sense of the word, as it is used about humans. Among these one may count more or less instinctive co-ordination of behaviour, such as it emerges among ants building heaps or honeybees gathering food. At the opposite side of the scale, we find co-operation that builds on elaborate long-term planning and discussion among the subjects who co-operate.

In this article, our aim is to compare and elucidate the similarities and differences between humans and apes as concerns co-operation. There is no doubt that apes co-operate, but, as we shall argue, humans are able to do so in more flexible ways. Our goal is to spell out the role of communication in different kinds of co-operation.

Co-operating means working together for a joint benefit: Agents together employ a certain means, or series of actions, to achieve a common end, or goal. Co-operation can be achieved directly by co-ordination of behaviour. It can also arise indirectly through a mutual sharing of representations of means and end.

In many cases, it seems that representations are not needed to stand in for the real thing, that is, for the means and the goal. If the goal is present in the actual context, for instance, water to drink, food to be had, or an antagonist to fight, it is not necessary to focus on a joint representation of it before taking common action.

But if, on the other hand, the goal is distant in time or space, then a shared representation of it must be produced before action can be taken. Humans have a powerful tool in language when it comes to creating shared representations and common goals. Language, as opposed to animal signalling, is not bound by the actual. It is based on the use of representations as stand-ins for actual entities. Use of representations replaces the use of environmental features in communication.

## 2. COMPETITIVE VERSUS COLLABORATIVE CO-OPERATION

Co-operation is often competitive. This means that it is undertaken with the view to out-compete, or win over, others. Co-operation may arise in direct competition about resources or as a response to threat. A group of apes may co-operate in order to defend themselves against a predator, or in order to get hold of some food from which the whole group will benefit. In both cases, the group will normally be better off working together than if a solitary ape would have taken action. A group may also compete directly with another group for resources.

But it may also be the case that the competitive co-operation is indirect and involves several successive goals. For instance, one way to take the advantage over a particular rival is by forming an alliance or coalition with other individuals, as an intermediary to the ultimate goal of winning over the rival. In such a case, the agent first forms an alliance with another agent in relation to an immediate goal. This is a case of short-term planning. However, the ultimate goal of the agent initiating the alliance is to achieve an advantage over a third party – a case of long-term planning. The following is an example of how apes may engage in alliances.

The zoologist Frans de Waal, in his classic book *Chimpanzee Politics*, describes how clever high-ranking chimpanzees are at manipulating others. The story of Yeroen is typical. He had for a long time been the dominant male in the flock, but was dislodged by Luik and later defeated by the young Nikkie. Instead of retiring, Yeroen now formed an alliance with Nikkie. Together they defeated Luik, who had sole right to the females. With the new ranking order – Nikkie at the top and Yeroen in second place – Yeroen could use his position to mate with some of the females. Nikkie could not protest with any vigour against this, since he was dependent on Nikkieís support in the struggle against Luik.

Co-operation presupposes that each participant understands at what the other participantsí actions aim. It seems that actions receive a meaning for apes when the actions appear in a competitive context, whether the competition is within or between groups. One ape understands why another ape performs a certain action, because the action is performed against a background of given and limited resources – food, partners, et cetera. The variables that are relevant in a certain situation are given by the context, and by having access to these, the ape can interpret the action accordingly. This line of thought can as well shed some light on another oftmentioned issue.

It has been emphasised that apes do not point declaratively in their natural habitat. This means that they do not point to inform, that is, to the benefit of others. They point imperatively to initiate an action that they themselves in a foreseeable future will benefit from. Experiments have been designed to decide whether apes, even though not pointing declaratively amongst themselves, would understand declarative pointing by humans. It seems that human-raised apes can learn to do so, although the evidence for that is not unequivocal. But why do apes not point

to inform? The answer may be that pointing only receives a meaning for apes when it occurs in a competitive context, that is, in a context of action, where the indication receives its meaning from the range of available resources.

Non-competitive or, as we will call it, collaborative co-operation occurs when co-operation does not take the form of an alliance against some other group. The collaboration is not introduced in order to compete for given resources. This means that the utilities in the environment that function as goals are not part of an existing pattern of co-operative behaviour in the group or among different groups. Then the goal can not receive its value by being an entrenched, limited resource competed for by others. Instead it receives a value independently of the established values in the shared and limited economy of competing agents. Its value will depend on if the agents can form a new economy by adding the new goal to the existing values, or if a completely new value structure will have to be created around it.

Obviously, when there is no established competition for the goal, its value is difficult to determine. It has to be estimated with regard to possible outcomes in the future. Calculating future values of goals demands cognitive resources that apes seem to lack.

In support of this, it should be noted that collaborative co-operation has not been observed among apes. This is an important difference between humans and apes. One reason why apes do not have collaborative co-operation may well be that such co-operation does not make sense to apes, because it does not serve a given end. The end is not prescribed by a competitive context or by the existing behavioural patterns of the group.

Collaborative co-operation is directed at goals that are not among the ones that are competed for in the normal case. Such collaboration is made possible by the capacity to imagine things that do not occur as part of the normal behaviour. This capacity requires that one can use detached, or context-independent, representations when planning to co-operate. How such representations work will be further described in the next section.

In summary, apes co-operate in order to win something that is available and accessible to them, but not yet in possession. Humans, on the contrary, can as well co-operate in order to achieve something that is so far only desirable and not manifest, and that does not have an entrenched, determinate value. The bases for the latter capacity will be fleshed out in the following sections.

## 3. MEANS AND ENDS

As mentioned above, co-operation involves agents, ends (or goals), and means (or actions) to achieve the end. The character of the goal and the ways it can be reached will determine the nature of the co-operation that the agents can engage in. Especially the actuality of the goal is a characteristic of interest for the present discussion.

Goals, say, food, can be characterised either as existing in the present (the ripe apples on the tree in front of you); as not yet existing, but as having precedents, and soon to be realised (the prey that will be hunted and then killed); or as being novel and yet only possible (the fish imagined to live in the unknown river you have just reached). Entertaining the last kind of goal requires that the agent can have goal representations that are detached from the present context, and also from previous contexts.

Detached representations can be increasingly context-free: firstly, they can be independent of the time and place in which their real referent, or what they are about, is situated, and secondly, they can be independent of having a referent at all (Gärdenfors 1996, Brinck and Gärdenfors 1999). In the latter case, they cannot acquire their meaning by standing for some item that exists in the real world. Humans may imagine what is not there, and, moreover, make their imaginations known to each other. Apes, however, do not have detached goal representations (Tomasello 1999). Apes are thus not capable of co-operating in order to reach a common goal that is not either present in or implicated by the immediate context (as by learning or memory of previous encounters with similar goals).

It has been suggested that time displacement by itself can result in detached representations of means or goal. But time displacement will not separate the goal from the original context. Neither will it transform perceptually based knowledge into conceptual knowledge. The reason is that the time displacement cannot by itself cause a change among the contextual elements *per se*, such as means or goal, or the way these elements are interrelated. It only pushes the context forward in time. The original context remains intact, except for its receiving a new time index. Detached representations, to the contrary, emerge when the representation can be severed from use in any kind of context.

The existence of imagined goals introduces a new kind of complexity into cognition. Co-operation builds on social knowledge, that is, knowledge about power relations between agents and about their respective affiliations (Byrne and Whiten 1988). Many situations that involve several agents demand tacit cost-benefit analyses of predicted actions and

outcomes before individual action can be taken. Such analyses require that there is information to be had about the agents involved, concerning ranking, kinship, and such. The analyses also require that the agents have knowledge about means and ends.

But if the goal is imaginary, its value is also imaginary. It does not constitute a stable resource and its value cannot be calculated. This has consequences for co-operation. Much co-operative behaviour is compensatory – it is performed in exchange for other actions that have already been performed or are anticipated. Grooming may be performed for the exchange of grooming itself or with the further end of getting support in future fights or alliances. During co-operative hunting, apes help each other because they have a common goal of sharing food.

The exchange that underlies compensation presupposes that the resources are known, or at least can be known. But in the case of imaginary goals, compensation becomes much more of a venture than a safe strategy. If individual agents cannot base their actions on an analysis that takes into account the estimated value of the goal, the collective outcome of strategic actions behind co-operation is shaken. Such a collective outcome is what is called an equilibrium in game theory. We will return to these issues in section 6, where we discuss co-operation in the light of game theory.

Similarly to goals, means can be characterised in different ways. While we characterised goals in terms of actuality, we describe means in terms of how they relate to their goal. Means can either be invariably connected to a certain kind of goal; they can be variable, in case there are different ways of reaching the same goal; or they can be novel and original. Tomasello and Call (1997) underline that in understanding behaviour as intentional, one understands that "different means may be directed toward the same end and that the same means may be used for different ends" (p. 361). As they see it, intentionality involves more than understanding that other agents can generate their behaviour spontaneously and that their behaviour is directed (p. 203).

What is intentional about the capacity to separate means and ends? Intentionality, or goal-directedness, emerges as an ability to adopt the means to the situation at hand. To be reached, the same goal may require different means in different contexts. And the same means may afford different goals in different contexts. Intentional behaviour is flexible. It depends on the agentís ability to appreciate the distinctive character of each context it encounters. It also depends on the agentís ability to learn about new contexts and how to deal with them.

According to Tomasello and Call (1997), chimpanzees cannot represent the goal without the means to reach it. Goal and means form an indivisible whole. Humans, on the other hand, can reflect about different ways of reaching the goal. Since humans also can produce goals that do not yet have analogues in the environment, human co-operation has the potential of being very flexible.

## 4. Co-operation and Communication via Joint Attention

Co-operation depends on communication. Agents will not be able to co-ordinate their actions, unless they can communicate about their present state and the action that will follow upon it. They need to communicate about the goal of the co-operation, as well as about their own and each otherís means to reach the goal. In many cases, communication can rely on display and signalling of the present and the next behavioural states. But sometimes co-operation stands in need of anticipation. This is the case when the goal is not present in, nor implicated by the actual context. It also happens when there are several possible goals, but none actual. Then communication cannot simply rely on contextual means or cues to transmit information between agents.

Signalling depends on causal influence between agents. Information can be transmitted causally by perceptual cues. The agents communicate by signalling their own states and action-readiness to each other. Co-operation sometimes does not need more than a chain of signals to issue in quite complex behaviour. The actions directly follow upon each other because they causally prompt each other. For example, a flock of flying geese in a V-formation seem to be involved in fine-tuned co-operation, but the formation is actually caused by the aerodynamic forces which make the V-formation the least strenuous for the geese.

But sometimes co-operation is more elaborated. For instance, perceptual cues of a certain type may prompt several kinds of behaviour. The appropriate behaviour is chosen with regard to the situation at hand and the goal. In order to produce the appropriate behaviour, the agents will have to check their mutual reactions to each other and to the goal. Consequently, for the co-operation to be successful, the agents must engage in joint attention. Joint attention is triadic: Agents attend not only to a shared object, but also to the attention of each other. Joint attention allows for two or more subjects to focus their perception simultaneously on a single attentional object (so-called mutual object-focussed attention) provided that the subjects have focussed on each other beforehand (so-called subject-subject attention) (Bruner 1998, Tomasello 1999, Brinck 2001).

In mere subject-focussed attention, attention is directed at the behaviour of other subjects. By, for instance, looking at each other, two subjects can detect their respective attentional objects. They do so on the basis of the direction of their respective movements in combination with a salient object that functions as a target. Co-ordination of attention based on saliency and behavioural co-ordination result in mutual object-focusing. Mutual object-focusing can spread automatically among subjects.

Joint attention is, as mentioned above, based on subject-subject attention and requires agents who actively seek goal-oriented information. It involves attentional co-ordination in the sense that the subjects attend to each other as subjects capable of attending. One might think that this necessarily involves having a theory of mind and being able to grasp that other subjects have mental states. But this is not the case.

An agent can read the attention of the other agents from their gaze and behavioural cues. The awareness of states of attention relies on evidence such as facial expression, gaze, and body posture related to a certain kind of action readiness and vigilance. Joint attention is based on information laid out in the environment as opposed to such attributed to mental states. Being aware of other subjects' capacity to attend consists in expecting them to manifest attentional behaviour.

Agents capable of subject-subject attention primarily attend to each otherís attentional states, not to the (non-attentional) behaviour that is a consequence of attending or of attaining joint attention. However, they extract information about the attentional states of others not explicitly as being about such states (which may have intentional components), but as the states are manifested in bodily behaviour. Such agents can distinguish non-attentional head and body orientation from attentional gaze, and can engage in attention contact, during which they simultaneously check each otherís state of attention, for instance, by eye contact (GÓmez 1994).

Agents that engage in subject-subject attention also attend to each other as capable of attending in a goal-intended way, that is, in a way that is not controlled by the object of attention. Goal-intention provides for the capacity to either direct or follow the attention of the other subject in the absence of salient objects (though not in the absence of objects altogether). This means that attention-focusing can be guided by the subjectsí mutual attention to each other instead of by what is happening around them.

Joint attention may occur in both competitive and collaborative co-operation. This capacity makes possible ways of co-operating that cannot occur without it. An example would be, when hunting a herd of antelopes, two agents can jointly attend to the same individual in the herd and thereby co-operate by taking different roles in killing the selected antelope. It has been argued that apes are not capable of joint attention (Tomasello 1999). If this is true, they would not be able to engage in this form of hunting.

## 5. Co-operation and Communication by Symbols

If the desired goal is not present in the actual context of the agents, the process of attention reading will not work for communicating about the goal. In order to communicate about absent goals, the agents must be able to first entertain detached representations, and then attend jointly to such representations. It seems hard to explain how this is done without evoking symbolic communication.

Tomasello (1998) describes symbols as social, inter-subjective, and bi-directional. Bi-directionality assures that a competent user who understands somebody else's use of a symbol as having a particular content can herself produce the symbol with the same content. Production and comprehension of symbols go together. Deacon (1996, 1997) explains how symbols acquire meaning by being related to each other in various ways, like opposition, substitut-ability, and adjacency. Symbolic reference depends on indirect reference to objects, with the help of other symbols.

Communication by symbols is quite intricate, because the meanings of the symbols are general and defined by interrelation. It has so far not been shown that apes can communicate in a fully symbolic way (Deacon 1997, Tomasello 1999). On the contrary, it seems that apes in their natural habitat, which have not been trained, mainly exploit indexicals in sign communication. That means that the signs the apes use acquire their meaning by standing in a causal and contingent relation to what the signs are about. Indexicals are dependent on the context for their meaning. This has the side effect that the same sign, or gesture, may be used with different meanings in different contexts. One can raise the arm to indicate, for instance, both danger and food. This stands in contrast to symbols that retain their meaning across contexts.

The use of symbols in thinking has the consequence of setting the agent free from desires imposed by the actual context. For instance, it may be hard to give up a utility in possession for a future, but more precious one. The reason is that the present utility seems so much more valuable than the one that can only be imagined. It has been shown that apes who have been trained to use symbols to think and communicate, instead of using the things themselves (as in indication), are able to plan for future desires, and not give in for present ones.

This is illustrated by an experiment with chimpanzees performed by Boysen and Bernston (1995). They put peanuts in two heaps of different size placed on a table out of reach of the apes. One ape was to point at one of the heaps, and then that heap was given to the other ape, while he himself got the one that he did not point at. The result of the test was surprising. The ape repeatedly pointed at the biggest pile and was very disappointed when that pile was given to the other one, and he himself received the small pile.

The chimpanzees consistently chose the bigger pile of food. The presence of the desired food seem to make them incapable of imagining the recurring near future when the other party receives the pile that they choose and they are left with the other pile. Boysen and Bernstonís experiment clearly shows how difficult it is to manage even the simplest form of planning for a future goal. Deacon (1997, p. 414) writes that the choice is difficult for chimpanzees since the indirect solution (choosing the small pile) is overshadowed by the direct presence of a more attractive stimulus, namely, the big pile. They cannot suppress their perception.

If one performs the same kind of experiment with human children, they have no problem choosing the small pile – from the age of two and up. They can imagine receiving the big pile when they point at the small one. When children are younger they behave more like chimpanzees. It has been shown that persons with autism have difficulties that closely resemble those of chimpanzees and small children (Russell *et al.* 1991).

The chimpanzees in Boysenís study were also trained to connect numerals with quantities, so that they knew that the figure 5 corresponded to a bigger pile of sweets than the figure 3. Once they had learned the meaning of the numerals, they were instead allowed to choose between two cards showing numerals, and the pile corresponding to the selected numeral was given to the other chimpanzee, while they themselves received the pile corresponding to the numeral they had not chosen. The results were now better: They could learn to select cards so that they received the big pile. The explanation is that there is no longer a conflict between the symbols they see and what they have to choose – the cards had no intrinsic value for the chimpanzees. This variant of the experiment is a form of conditioning, which is no problem for chimpanzees.

Why is it cognitively more difficult to plan for future needs than for current ones? The answer has to do with the different representations that are required for the two types of planning. When planning in order to satisfy current needs, one must be able to represent actions and their consequences, and to determine the value of the consequences in relation to the needs one has at that moment. But no separate representation of that need is required. To plan for future needs, on the other hand, one must also be able to represent these potential needs (and to understand that some of them will arise). The available ethological evidence so far indicates that man is the only species of animal with the ability to imagine future wishes and to plan and act accordingly (Gulz 1991). Deacon (1997) calls our thinking front-heavy; anticipatory planning takes place in the frontal lobe, the most recently evolved part of the brain.

Human language is the prototype example of a symbolic communication system. Clearly, human language paves the way for long-term co-operation and for co-operation towards as yet unrealised, perhaps indeterminate, future goals. The goals and the means to reach them are picked out and externally shared through the linguistic medium. This kind of sharing gives humans an enormous advantage concerning co-operation in comparison to other species. We view this advantage as a strong evolutionary force behind the emergence of symbolic communication.

Humans can co-operate even when the desirable goal is remote from the conditions set by the environment. Since humans can have detached representations of both means and goals, and also can separate means from goal representations, the possibilities that co-operation opens up for the future are extensive. The environmental conditions can be completely transformed in order to give way for the means considered necessary to produce or realise an imaginary goal.

Humans have often used such tactics in history. Whole landscapes have been not only transformed, but even created from scratch to make room for new inventions and the realisation of new desires. One example is the capital of Brazil, Brasilia, that was built in the end of the 50s by Costa and Niemeyer. The design of the city was guided by a vision of a modern and technologically based future. Another example is the artificial irrigation that has made possible agriculture in desert landscapes, and yet another the construction of water pools or reservoirs to either exploit or change the reaches of rivers.

## 6. Competitive and Collaborative Co-operation in Game Theory

In section 2, we introduced two concepts of co-operation. Competitive co-operation is undertaken with the view to win over others. The goal of the co-operation has a certain value, because it is a limited resource competed for by a group or groups of agents. Cost-benefit analyses can be used to choose a strategy

for reaching the goal. It is often assumed that tacit cost-benefit analyses underlie competitive co-operation among animals.

Collaborative co-operation, on the other hand, occurs when the end that is pursued is not well entrenched in the behaviour of the agents that engage in co-operation. The goal receives its value without being a part of the shared economy of competing agents. A new value situation can be created that is not, at least not initially, accessible for all agents in the whole group or society of agents. Only those agents that introduce the new goal are in full control.

Collaborative co-operation demands access to detached representations, and the capacity to communicate about such representations. Competitive co-operation, on the other hand, can make do with indexical representations. The communicative skills required by competitive co-operation are therefore less demanding than those required by collaborative co-operation.

In classical game theory, a strict partitioning between co-operative and non-co-operative games is made. A game is said to be co-operative if the players have full information about each otherís choices, while it is said to be non-co-operative if they have no information whatsoever about the other playersí choices. However in real games, the two extremes of co-operation and non-co-operation are rarely attained. In most cases a player has only partial information about the potential behaviour of his opponents, either as a result of memories from earlier, similar situations (for instance, in iterated games) or as a consequence of other kinds of expectations.

As a paradigm case of how different kinds of co-operation affect a game situation, let us look at how different kinds of information about the other players affect choice situations of the prisonersí dilemma (PD) type. In a PD game the players have two options – to co-operate or to defect. The outcomes are such that your best individual strategy is to defect, independently of whether the other players co-operate or defect. However, if all players defect, the outcome is much worse than if everybody co-operates.

If the PD is seen as a purely co-operative game, traditional game theory prescribes the co-operative strategy as the only rational one for all players. In contrast, in a purely non-co-operative PD, the theory claims that defecting (the non-co-operative strategy) is the only rational strategy.

It turns out that in real situations where the game is described as a non-co-operative one, human subjects (and animals) often choose the co-operative strategy, in contrast to what is recommended by game theory. In our opinion, the reason for this seeming irrationality is that a PD type situation is seldom treated as a strictly non-co-operative game. Even if a subject does not have any real information about her opponentsí choices in the situation, she has expectations about their behaviour. For example, she may count on that they reason in the same way as she does herself, or that they would, like herself, feel ashamed if they chose the defecting strategy.

Such expectations function as information about the choices of the others that effectively make the game situation partly co-operative. In such a situation, the rational move to make may very well be to co-operate. Since it is hard to imagine a game situation where a human player has no expectations whatsoever about the opponents, it is questionable whether the pure non-co-operative situation prescribed in game theory can ever be attained.

In experiments with iterated versions of the PD, animals as well as humans tend to choose strategies that result in mainly co-operative solutions (Axelrod and Hamilton 1981, Axelrod 1984). A popular strategy in iterated two-person PD games is “tit for-tat”, which means that you start by co-operating and then choose whatever option your opponent chose in the preceding game. In iterated games, expectations are built up from the memories formed by learning from earlier game situations. Animals with comparatively limited cognitive capacities can attain this kind of learning. In some cases, the co-operative strategy can even be genetically determined.

Another important factor in PD type games is that among social animal species, and humans in particular, the possibility of sanctions from the rest of the group may drastically change the game situation. Even if you temporarily gain by defecting in a (non-iterated) PD situation, the risk of being punished by the peers in the group for such a non-co-operative (egoistic) behaviour should be taken into account when calculating the utilities of the available strategies. If the punishment is severe and the risk of receiving it high enough, the payoffs of the game will change in such a way that it no longer is a PD, but a game where the only rational strategy is to co-operate. Consequently, including expectations about sanctions is a way of changing the rational equilibria of a PD type game into a game with only co-operative equilibria.

As a side remark, shame is likely to be a bodily reaction that expresses an expectation of scorn or punishment, the function of which is precisely to alter the expected utilities in a PD game situation, where one is tempted to defect. We suggest that shame and its associated behaviours have evolved in order to change the perceived outcomes from a PD situation into a game where the co-operative strategy is favoured. The general evolutionary mechanism that is

proposed here is closely related to the mechanism behind altruism.

In line with the general tenet of this paper, we claim that the presence of shared, detached representations of a future goal will by themselves change a situation, which would be a PD without the presence of such representations, into a game where the co-operative strategy is the equilibrium solution. For example, if we live in an arid area, each individual (or family) will benefit by digging a well. However, if my neighbour digs a well, I may defect and take my water from his well, instead of digging my own. But if nobody digs a well, we are all worse off than if everybody does it. This is a typical example of a PD.

Now if somebody communicates the idea that we should co-operate in digging a communal well, then such a well, by being deeper, would yield much more water than all the individual wells taken together. Once such co-operation is established, the PD situation may disappear, since everybody will benefit more from achieving the common goal. In game theoretical terms, digging a communal well will be a new equilibrium strategy. This example shows that the capacity of sharing detached goals in a group strongly enhances the value of co-operative strategies within the group. Strategies based on detached goals may introduce new equilibria that are beneficial for all participants.

The problem is, as mentioned above, that in collaborative co-operation, the goal may be imaginary, without any precedent, like the communal well in the example. If the goal is imaginary, its value will be so too. It will be difficult to make estimates concerning the behaviour of other agents based on learning from previous situations, since the situation is new and unknown. In this case, the individual players will have to change the general structure of their expectations to accomodate the new situation.

Therefore, the efficiency of the communication about a detached goal will be a bottleneck in changing the strategic situation of the group. In the example of the communal well, communication via joint attention is not sufficient since there is no well to attend to. In such a case, symbolic communication is necessary. However, it is not sufficient to communicate the plan for a well of an unknown type, but the community must also be convinced of the *value* of the well. This is where rhetoric enters on the scene – those who have a talent for convincing others that a common future goal is valuable have a better chance of driving through the co-operation.

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