

Money is a token of cooperation: The biology of indirect exchanges

Jose Maanmieli

j.maanmieli@gmail.com

Abstract: I propose an objective definition of money through a biological definition of cooperation, as opposed to altruism. I argue that these types of sociality are confused because they are not evaluated from a situated perspective of animal interactions. The theory of reciprocal altruism does not correctly model the human exchange of goods and services. These constructive economic interactions require the ability to choose partners based on individual preferences. On the other hand, altruism presupposes partnership under a common standard of value. Therefore, the nature and evolution of money cannot be explained by conceptualising it as a token of altruism or as a form of credit. Rather, money is a transferable signal that enables cooperative interactions between distant or unrelated individuals. This behavioural definition similarly proposes an understanding of morality and human society as strategies of indirect reciprocity in the context of game theory.

Keywords: game theory, animal signals, partner choice, social evolution, morality, credit

1. Introduction

Buying apples is an act of cooperation, a win–win interaction between a seller who wants money and a buyer who wants apples. However, when they receive their respective items, buyer and seller typically say, ‘Thank you!’ This can be a puzzling response: Do these individuals act out of self-interest or out of concern for each other?

Today’s market exchanges appear to be impersonal, rational and individualistic. Anthropologists have also regarded the market economy as fundamentally different from a traditional gift economy [1] (p. 55). However, gifts have always served to cement important relationships of gratitude and debt [3,4]. Humans give altruistically to ‘put people under obligations’ [2] (p. 73).

This traditional behaviour relates to the difficulty in defining cooperation, money and other social phenomena [5,6,7]. Notably, Dawkins has referred to money as a ‘formal token of delayed reciprocal altruism’ [8] (p. 188), in which altruism is seen as the cooperative and moral basis of society. This biological definition explains why the seller is grateful for receiving dollars from the buyer, as this formal token enables the seller to obtain, for example, oranges from someone else. However, imagine that the seller of oranges does not accept dollars. Are they acting immorally and against their own interests? Are they a cheater who deserves punishment for not returning a favour? The answer is probably ‘no’, as this seller may accept other tokens, apples, labour or even nothing at all in exchange for oranges.

This example illustrates the error of adopting a sociocentric perspective on interactions. From the perspective of a society of people who believe in the value of the dollar, this token is considered money because it enables exchanges that appear to be cooperative. However, a genuinely biological definition of money and cooperation cannot rely on beliefs or cultural values. In this article, I define cooperation in objective, behavioural terms. In Section 2, I distinguish it from altruism in the context of barter or direct exchanges. In Section 3, I show that some tokens perform a signalling function that enables indirect exchanges between distant or unrelated individuals. I argue that dollars and other kinds of ‘money’ should be called credit because they mediate altruistic exchanges instead of cooperative ones. Finally, I provide a brief explanation of the role of language in confusing credit with money.

2. Direct exchanges

Imagine that the above sellers of apples and oranges are farmers (A and B, respectively) who barter their products instead of relying on money. This direct exchange is cooperative in the sense that A and B work *together* (the etymology of cooperation). Namely, A produces apples to give to B because B produces oranges to give to A and vice versa; otherwise, A and B would work *separately*, producing for self-consumption.

An exchange can thus be seen as a constructive interaction between intentional agents that have complementary goals: A wants oranges more than apples, and B wants apples more than oranges, so they have chosen to provide for each other (cooperation, c) instead of only for themselves (noncooperation, nc). These interactions are well modelled by the game of Stag Hunt, as shown in Figure 1.

| | | |
|------|-------|-------|
| | c | nc |
| c | 2, 2 | -1, 1 |
| nc | 1, -1 | 0, 0 |

Figure 1. Player A chooses one of the row actions and player B chooses one of the column actions. The cells contain the payoffs, or benefits, that A and B respectively receive depending on their choices. The letters c and nc indicate cooperation and noncooperation (cf. defection in Fig. 2), respectively.

This game presents two Nash equilibria at (nc, nc) and (c, c) : if players choose the same strategy (either producing for exchanging or for self-consumption), no player is better off by deviating from it unilaterally. Furthermore, players have an incentive to choose the c strategy and signal this choice to others, since bringing about coordinated action results in the greatest benefit (2 in Figure 1). In the previous example, A might begin by offering apples and requesting oranges. These signals are received by B, who begins producing oranges for A because B wants apples. This behaviour in turn reassures A in their strategy of producing apples, now directed at B instead of someone else. Signals help coordinate A and B's cooperation, solving the problem of partner choice.

In contrast, theorists tend to view cooperation in the context of the Prisoner's Dilemma (see Fig. 2).

| | | |
|-----------|-----------|----------|
| | <i>nd</i> | <i>d</i> |
| <i>nd</i> | 0, 0 | -2, 2 |
| <i>d</i> | 2, -2 | -1, -1 |

Figure 2. The letter *d* indicates defection and *nd* indicates nondefection, as opposed to cooperation. Exchanges occur when players avoid mutual defection, i.e. players have an obligation to give and reciprocate.

This is because cooperation is understood simply as incurring a ‘cost in order to provide a benefit for another person or people’ [9]. That is, cooperation is not a strategy in the sense of intentional behaviour; rather, it is a form of payment, a transfer of value measured in a single currency, e.g. quantity of fruit, dollars or reproductive fitness, from one organism to another [9,10]. However, here ‘cooperation’ (nondefection) is not a Nash equilibrium: B may benefit from receiving apples from A in exchange for oranges (*nd, nd*), but B is better off defecting (*d*) since having more fruit (or dollars or fitness) is better (Fig. 2). The only Nash equilibrium is in the case of mutual defection, which can be pictured as A and B guarding their fruits and sending dishonest signals on their intention to exchange them.

Hence, the Prisoner’s Dilemma is not an adequate model for cooperation if cooperation is understood with reference to observable behaviour, such as that of trade. Cooperation occurs when organisms act together when they could act apart. It is a behaviour establishing a relationship that did not exist before, one in which A (or B) obtains a greater benefit by their own value standard. Cooperation cannot be defined coherently by assuming that A and B are already in a relationship in which they share a value standard. Rather, this situation of imprisonment provides a model for the concept of altruism, as opposed to cooperation.

Altruism is found primarily in human societies, in which individuals are already committed to helping others who share values such as the same currency, god or nation. In this sociocentric view, A produces apples for a certain B and hopes that B will abide by their obligation to reciprocate. In contrast, from an objective perspective of cooperation, A produces apples for B simply because B shows a reliable intention to give oranges to A.

3. Indirect exchanges

An indirect exchange can be reduced to a sequential game between A, B and a third party, C. Imagine that B wants bananas instead of apples; A still wants oranges but can only provide apples. Therefore, B's decision to provide oranges depends on whether they can eventually get bananas from C; otherwise, A will have exploited B. To solve this problem, A can issue a token that represents a promise of reciprocity. As illustrated in the introduction, B can use this token to obtain bananas from C only if C accepts it, i.e. only if C believes that A will eventually honour their promise and accept the token back in exchange for apples.

This reduction elucidates why morality, too, has been described as a system of indirect reciprocity [11,12]: 'I help you because someone else will help me', where 'help' represents an altruistic payment in the common currency of reproductive fitness. Thus, from a sociocentric perspective, the token works because A, B and C morally help each other. However, objectively speaking, A's incentive remains to receive B's help and avoid helping a distant or unrelated C. Therefore, the evolution of money and indirect reciprocity cannot be adequately explained [13,14]. Furthermore, it is difficult to view C as defecting because they refuse to accept B's token, or to view B as cooperating because they then refrain from stealing C's bananas.

On the other hand, if reciprocity is seen as cooperation, the evolution of indirect reciprocity is only a problem of coordination between animals that have the freedom to act separately. In Stag Hunt, players can choose to be in a situation of neither defection nor cooperation (*nc*, Fig. 1). This situation of freedom provides an objective reference frame, as well as a notion of ethics that contrasts with morality [15]: If B gives oranges to A but C does not give bananas to B, C is merely not cooperating rather than being unethical. The costs incurred by B, as a farmer or specialist, are not too important (-1 , Fig. 1), and C may be missing out on future benefits. Likewise, if B does not try to steal C's bananas, then B is behaving ethically.

Thus, to ensure that B cooperates with A, A can secure a token having a similar desirability to apples, oranges and bananas. Rather than symbolising a promise in the common language or symbolic culture of A, B and C, this token is a natural signal that establishes a relationship between A, B and C independently of convention.

3.1. Money

The fundamental problem that A faces is that it is difficult to find an orange producer B who will

want the apples that A can produce, so A has little incentive to adopt this cooperative strategy. However, B and C face the same problem given their respective preferences and abilities. To solve this, A, B and C try to obtain something similarly unique.

Let us assume that A finds the only seashell in the area, from which A crafts two beautiful beads [16]. The difficulty in obtaining these beads is such that A will find it easier to provide apples to get them back in the future. Thus, when A offers the beads to B in exchange for oranges, B has no good reason to refuse, knowing that a potential banana provider, C, will be in the same position. The beads solve the problem of partner choice in the context of indirect exchanges. They function as a reliable signal that coordinates cooperation between separate individuals or groups.

The fruits in this example represent any investment an individual or group would make in exchange for something similarly unique, yet durable, transferable and divisible. For example, A might want to keep one bead in case they later need emergency assistance. Like oranges, this assistance may be available from B at a small cost without reciprocity (B gains -1, Fig. 1); however, by offering the bead, A can ensure that B will assist them instead of someone else (B gains 2, Fig. 1). Therefore, even when shell beads are plentiful, they need to remain as special and hard to obtain as the instances of cooperation that they are expected to mediate.

Shell beads are also signals in the biological sense of the word, meaning that their main function is to elicit responses from receivers [17]. However, their transferability sets them apart from other animal signals. Items as diverse as hand axes [18], ivory beads, dried grains, salt, pieces of precious metals, yap stones and bitcoins all have these signalling properties in their respective contexts of use. Bitcoins, in particular, are unique and transferable, yet immaterial, which highlights the present definition of money as a signal [19].

This definition elucidates the ‘collecting instinct’ of humans, our ancestral tendency to collect rare items [20]. However, in the present view, these items are not mere collectibles or primitive money. Rather, they can be seen as money to the extent that they enable cooperation among dispersed human groups. A seashell is money if it mediates a single indirect exchange in the absence of trust. As described above, shell beads are favoured because their uniformity and divisibility improves economic calculation. Today, our advanced economy benefits from the uniformity and divisibility of digital information. However, these signals cannot be money if they lack the natural uniqueness of shell beads.

3.2. Credit

Money should not be confused with items whose artificial uniqueness is tied to the needs of a particular person or group. Consider the case discussed at the beginning of Section 3, in which A issues a promise of payment, instead of finding seashells. This promise requires linguistic signals in the form of speech, a symbolic token or a written record. These signals can go from one person to another in the manner of money; for example, B receives A's token and later gives it to C in exchange for bananas, or an authority registers C as the new creditor of A. However, these signals are merely a conventional representation of A's debt.

These transferable, linguistic signals are thus a form of *credit*, as opposed to money. They mediate indirect exchanges that begin with B's altruism towards A and end with A's reciprocal altruism towards C or someone else. In this way, A cancels their debt; the token is destroyed or the signals cease to indicate credit. However, there is a further possibility of making linguistic signals pure credit, in the sense of a token containing no reference to an identifiable debtor, a claim against 'everyone *in a society*' [21].

Imagine that A is an institution that issues symbolic tokens that are declared to be money. In this case, the interpersonal concept of credit-debt vanishes in people's minds [21]. The tokens have acquired a 'thingness' that resembles shell beads. Therefore, A does not have to provide apples to C; instead, A can issue more credit, enabling C to obtain their apples from an additional party, D, and so forth. This activity corresponds to the function of banks as suppliers of 'money'. However, these tokens cannot be money because their uniqueness cannot be trusted.

Hence, by imitating money, credit exploits the human instinct to collect rare items and cooperate. Today, people collect certain digits issued by banks because a government has declared them legal tender: ultimately, B has an obligation to accept them (Fig. 2). These tokens are valued and circulated because this norm stimulates their use, creating a network effect that is driven by spending (A's desire for oranges) rather than saving (A's interest in a future reward). Historically, however, the acceptance of credit in a population relies on money. For example, the dollar used to be backed by gold, just as the first coins featured symbols (credit) inscribed on an unforgeable piece of precious metal (money). This natural basis is necessary given the instability of altruism as a strategy for indirect exchanges.

4. Conclusion

The word 'money' comes from the Latin word *moneta*. Moneta was an epithet of the goddess Juno, the protectress of funds, in whose temple the mint of Ancient Rome was located. The etymologies of Juno and Moneta are associated with the word 'unique', as well as words that suggest the morality of keeping a promise, such as 'remind' and 'warn'.

The concepts of money and credit are similarly intertwined today. Definitions build on seemingly objective notions, such as value, or sociological notions, such as the acceptance of something as money in a community. In this article, I have attempted to clear this terminological confusion through a focus on ordinary interactions. This biological analysis separates the objective concept of money from the subjective concept of credit and similarly distinguishes cooperation from the traditional value of altruism.

The act of buying apples, then, can either be pictured as a cooperative strategy taken by an organism in nature or as a person becoming a debtor in a certain normative context. The latter sociocentric perspective is incorrectly adopted by evolutionary game theorists when picturing organisms that receive payments in the abstract currency of reproductive fitness. This error suggests that our understanding of nature is influenced by the demands of everyday life, such as when we are required to say, 'Thank you!'

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