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by

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Hayek Reads the Literature on the Emergence of Norms*

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Abstract. Hayek's approach to cultural and institutional evolution has been frequently criticized because it is explicitly based on the controversial notion of (cultural) group selection. In this paper this criticism is rejected on the basis of recent works on biological and cultural evolution. The paper's main contention is that Hayek employed group selection as a tool for the explanation of selection among several equilibria, and not as a vehicle for the emergence of out of equilibrium behavior (i.e. altruism). The paper shows that Hayek's ideas foreshadowed some of the most promising developments in the current literature on the emergence of norms.

Keywords: Hayek, cultural evolution, group selection, social norms

JEL Classification: B31; B41

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1. Overview

Hayek's theory of the emergence of systems of rules of behavior has attracted a fairly large amount of attention in the last two decades, and it has usually been dismissed as incompatible with modern evolutionary thinking and with Hayek's own methodological individualism. Most of the criticisms are focused on Hayek's reliance on the notion of cultural group selection, which is the idea that social norms and institutions evolve because they confer advantages to the groups that adopt them. In a seminal article on this topic, Victor Vanberg reached the conclusion that "the notion of cultural group selection is theoretically vague, inconsistent with the basic thrust of Hayek's individualistic approach and faulty judged on its own grounds." (Vanberg, 1986: 97)[1]

This topic has attracted so a large audience because scholars are intrigued to see (a) a prominent defender of methodological individualism to employ a controversial notion with an holistic flavor such as group selection; and (b) a champion of individualism and self-interest to embrace a peculiar view of (biological) evolution that has been traditionally invoked to demonstrate the possibility of altruism.

Unfortunately, while a large part of this literature is focused on the developments of the unit of selection debate within biology, much less attention has been devoted to what Hayek really intended with "group selection".[2] The standard reading of Hayek has been that he appealed to group selection to explain the emergence of norms that are open to free-riding, that is to say the norms individuals prefer not to follow although they are beneficial at the group level. If this reading is correct, one can easily agree with Vanberg that "the same basic argument […] that cast a doubt upon the notion of group selection in biology, seems equally to undermine the notion of cultural group selection" (Vanberg, 1986: 87) favored by Hayek.

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[1] See also Barry (1979) and Ullmann-Margalit (1977) for two earlier presentations of this point of view. Another strand of the literature focuses on the alleged "panglossian" nature of Hayek's evolutionism, which is his idea that surviving institutions are *ipso facto* desirable and efficient. See for example Whitman (1998), Denis (1999) and Kerstenetzky (2000). To keep this article within reasonable limits, I will omit a discussion of this point.

[2] Some of this literature shares the view that an eventual rehabilitation of group selection within biology will also contribute to make Hayek's views more presentable. See Hodgson (1991) for this approach.

In this paper I shall try to show that recent developments in the game theoretical explanation of social norms allow for a different reading of Hayek's works. In Sections 2 and 3 I will contend that Hayek had a peculiar view of group selection in which altruism played no role. His theory was intended to explain the selection among several (possibly unstable) equilibria, and not the emergence of out-of-equilibrium behavior, which is the typical case treated by biologists interested in the emergence of altruism. I will also show (Section 4) that, contrary to what has been claimed (for example by Bianchi, 1994), Hayek was perfectly aware of the problems generated by free-riding, and that he proposed an original and interesting solution to them.

I'm not claiming that the only way to read Hayek's cultural evolutionism is the one proposed here. When Hayek developed his theory of group selection the vast array of technical tools elaborated in the last two decades by game theorists were absent or rudimentary. Inevitably, his view of cultural evolution mixes and confuses several issues we can easily distinguish today. Hayek himself presents his theory of the emergence of norms as an application of the notion of group selection as it was developed within biology in the 60.s, which proves that the alternative reading is not without ground. My overall impression is that Hayek was the first to miss all the implications of his theory, which became apparent only with the most recent development of game theory.

To appreciate how close Hayek went to current speculations on the emergence of norms, in the second part of this paper (Sections 5 and 6) I will present two very simple models that I believe offer the best approximation to Hayek's theory of cultural evolution in terms of modern evolutionary game theory. In elaborating these models I have taken heavily from the large literature on the emergence of norms that flourished during the past two decades, thus intentionally avoiding any originality. In so doing I intend to show that, far from being a simple historical curiosity, Hayek's theory of cultural evolution foreshadowed some of the most interesting developments in current evolutionary theorizing in the social sciences.

2. Hayek on cultural group selection.

Hayek's theory of the emergence of systems of rules of behavior is a part of a more general project of a theoretical social science in which the center of the stage is occupied by

the spontaneous emergence of social order and cooperation. Since this part of his scientific production has been covered by numerous book-length treatments (see for example Barry, 1979, Kukathas, 1989 and Kley, 1994), I will be rapid in summarizing it.

Hayek maintains that social order is generated spontaneously by individuals following shared rules of behavior (or, better still, *systems* of rules of behavior). The spontaneous coordination of a multitude of individual actions generated by market transactions that attracted the attention of XVIII century forerunners such as Mandeville and Smith is just a particular case of a more general process of spontaneous order formation that involves all aspects of social life.

However, Hayek believed that rule-following is a necessary, but by no means sufficient, condition for the generation of a viable social order. In fact, some systems of rules of behavior bring about more efficient social orders than others, while a large class of norms would make social life utterly impossible. Hence, social life is possible only if there is a process that selects (reasonably) efficient systems of rules of behavior, within the large set of theoretically possible alternatives. Because of Hayek's well known anti-rationalism, this process cannot involve conscious choice and design.

Hayek had an optimistic view of this issue. He maintained that norms and institutions that bring about efficient social orders have more chances of being selected, while dysfunctional alternatives will die out in the long run. Here is where the group selection hypothesis enters the scene. For, Hayek invoked the notion of *group selection* to support his thesis that "the natural *selection* of rules" operates "on the basis of the greater or lesser efficiency of the resulting *order of the group*." (Hayek, 1967: 67.) According to Hayek,

> [t]he cultural heritage into which man is born consists of a complex of practices or rules of conduct which have prevailed because they *made a group of men successful* but which were not adopted because it was known that they would bring about desired effect. (Hayek 1973: 17, italics add[3])

Similar statements are scattered in all the pages Hayek wrote on cultural evolution. Quite paradoxically for an author who is usually considered one of the founding fathers of contemporary individualistic approaches to the social sciences, it never occurred to him

[3] Hayek's *Law, Legislation and Liberty* was originally published in three different volumes. I will give the reference to the original date of publication of the single volumes. So for example Hayek (1973) refers to the

that social norms and institutions could evolve because they confer benefits to the *individuals*, and not necessarily to the *groups*, who adopted them.

In elaborating his theory of the emergence of systems of rules of behavior, Hayek was deeply influenced by such unorthodox views on evolution as the ones developed by Carr-Saunders (1922) and Wynne-Edwards (1962). Although they worked in different fields (Carr-Saunders was mainly interested in cultural evolution, while Wynne-Edwards was a biologist) both choose as a starting point the population problem. They maintained that in animal species as well as in human societies, rules of behavior that produce as a side-effect the regulation of population density to its optimal level emerged via a selection process operating at group level.

Surprisingly enough, Hayek accepted Carr-Saunders and Wynne-Edward's thesis that social norms are shaped by group selection, but reached a completely different conclusion. He claimed that cultural group selection acted in such a way as to *maximize* population density and not regulate the population growth.

> What is often represented by biologists (e.g. Carr-Saunders, 1922, Wynne-Edwards, 1962) [...]) as primarily a mechanism for limiting population might equally well be described as a mechanism for increasing, or better, for adapting, numbers to a long-run equilibrium to the supporting power of the territory, taking as much advantage of new possibilities to maintain larger numbers as of any damage which a temporary excess might cause. (Hayek, 1988: 156.)

This difference was probably due to Hayek's emphasis on the improvements in the efficiency in resource exploitation due to cultural evolution. In his view, cultural evolution favors not so much those populations that can limit their growth *given* their ability to exploit scarce resources, but rather those cultures that stumble upon more efficient ways to exploit their environment. Since competition among cultures leads to the survival of the most efficient ones, it seems natural to expect that the surviving populations will be more numerous than the populations they superseded.

This link between cultural evolution and population growth became prominent in Hayek's last book, *The Fatal Conceit*, published in 1988. The following are some of his typical formulations.

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first volume, *Rules and Order,* originally published in 1973. However, the page numbers refer to the complete edition of *Law Legislation and Liberty*, *i.e.* Hayek (1982).

> The various structures, traditions, institutions and other components of this order arose gradually as variations of habitual modes of conduct were selected. Such new rules would spread not because men understood that they were more effective, or could calculate that they would lead to expansion, but simply because they enabled those groups practicing them to *procreate more successfully* and to include outsiders. (Hayek, 1988: 16.)

> [It] must be remembered that why men should ever have any particular new custom or innovation is of secondary importance. What is more important is that in order for a custom or innovation to be preserved, there were two different prerequisites. Firstly, there must have existed some conditions that made possible the preservation through generations of certain practices whose benefits were not necessarily understood or appreciated. Secondly, there must have been the acquisition of distinct advantages by those groups that kept such customs, thereby enabling them *to expand more rapidly than others* and ultimately to supersede (or absorb) those not possessing similar customs. (Hayek, 1988: 43. Italics add)

> The close connection between population size and the presence of, and benefits of, certain evolved practices, institutions, and forms of human interaction is hardly a new discovery. [...] [T]he American historian James Sullivan remarked, as early as 1795, how the native Americans had been displaced by European colonists, and that five hundreds thinking beings could prosper in the same area where previously only a single savage could 'drag out a hungry existence' as a hunter. (The native American tribes that continued to engage primarily in hunting were displaced also from another direction: by tribes that had learnt to practice agriculture.) (Hayek, 1988: 120 f.)

These quotations (especially the second and the third) show that Hayek confuses two different issues. In some places he says that cultural group selection favors those groups following rules that enable them to "*expand more rapidly than others*". In other places he says that the favored cultural rules are those that can sustain high population densities. But these are clearly two different issues, for it is not generally true that the faster a population grows the higher its equilibrium density will be. Hayek fails to say clearly whether he thinks that the determining factor in cultural evolution is the rate of population growth, or the final equilibrium density (or a mixture of the two) and this makes his theory rather unsatisfying.

Despite this is its most obvious weakness, Hayek's theory of cultural group selection has been mostly criticized because of its alleged incompatibility with another aspect of his thought: methodological individualism. Group advantage, so this criticism goes, cannot explain why single individuals adopt a given norm. Most of socially beneficial social norms are open to free-riding: single individuals benefit from infringing them even when they all

generally respected by their peers. Hayek's theory of cultural evolution was thus open to the same criticisms that decreed the end of group selection as an explanatory device in biology. Since Hayek's view of cultural evolution was shaped mainly during the 60.s, when the group selection arguments were still respectable in biology, most commentators concluded that his entire evolutionary approach is an unfortunate example of bad timing. Hayek' based all his views on this subject on a theory that was about to be dismantled within a few years. The next section shows why this view is inaccurate.

3. The Group Selection Hypothesis and its Critics.

The history of the group selection controversy is well known, as it has been told several times.[4] Here I shall only focus on its development after the publication of Wynne-Edward synthesis appeared in 1962, which is germane for the evolution of Hayek's view on this topic. Short after the publication of Wynne-Edward's book, in 1966, in his classical *Adaptation and Natural Selection*, G.C. Williams wrote that although group selection is theoretically possible, it is highly unlikely (Williams, 1966). He maintained that group selection models can be constructed, but also that they can produce a workable group selection only for a very narrow set of assumptions. Too narrow for those models to be considered realistic. In the subsequent years, this conclusion became a commonplace among biologists (Wilson and Sober, 1998: 5) and the publication of some books sternly critical toward group selection (such as Dawkins, 1976) simply repeated what the vast majority of them already believed at that time.

During the 70s, probably because of this growing tide of criticisms, Hayek became more cautious in his statements about group selection. He continued to believe, however, that group selection was applicable, if not to *biological* evolution, at least to *cultural* evolution. In the last book of *Law, Legislation and Liberty*, Hayek wrote that

> Although the conception of group selection may now not appear as important as it had been thought after its introduction [...] there can be no doubt that it is of the great importance for cultural evolution. (Hayek, 1979: 202, note 37.)

[4] Short and up to date accounts of this controversy are in Sober (1993), Wilson and Sober (1994), (1998). Wilson and Sober sympathise with group selection. For a version of this dispute written by a member of the opposite side see Maynard Smith (1976).

However, Hayek did not explain why there should be a difference between genetic and cultural evolution (group selection being possible in the latter but not in the former) and why the arguments that militate against group selection in biology should fail within social sciences. Strangely enough for an author who loved forays into different fields and disciplines, Hayek never felt the need to enter the arena where biologists were debating this issue.

However, Hayek had plenty of reasons to ignore (as he did) the debate that was raging among biologists about the unit of selection problem. This was due partly to the fact that many group selection models proposed during the 70.s (for instance Gilpin, 1975) were still focused on the limitation of population growth. But there was a second, more important reason: *group selection* was usually employed by biologists as a device to explain *altruism*. The main task of most group selection models was (and in many cases still is) to explain the emergence of individual behavior that is beneficial for the group and harmful for the individual (this is the technical definition of altruism).

Hayek was notoriously skeptical about altruism. He thought that altruism is a moral sentiment evolved in the first stages of human evolution (when humans lived in small, face-to-face groups of hunters and gathers), and that it is (probably) entrenched in our genetic code. However, he also thought that the more recent *cultural* evolution had produced systems of rules of behavior which provide individuals with *incentives* to act in ways that make the emergence of an extended net of social cooperation possible. He conceived the norms and institutions of the "great society" (markedly private property and market freedom) as "altruism economizer": they allow individuals to cooperate even if they are not interested in their fellows' welfare. In this newly formed cultural context, altruism became a hindrance to the formation of social order, and the source of the much discussed "discontent of civilization". (Hayek, 1979: 165 ff. and 1988: 64)

This skepticism about altruism might have been the cause that lead Hayek to give a completely different task to group selection from contemporary biologists (and, for that matter, sociobiologists). To understand this point, it is essential to recall that according to Hayek

> not every regularity in the behavior of elements does secure an overall order. Some rules governing individual behavior might clearly make altogether impossible the formation of an overall order. [...]

> Society can thus exist only if by a process of selection rules have evolved which lead individuals to behave in a manner which makes social life possible. (Hayek, 1973: 44)

For Hayek, what is in need of an explanation is not so much the fact that individuals respect the rules usually followed in the society they belong to, but how societies made by limitedly rational people can converge towards those rules that bring about (once generally followed) a workable social order. For Hayek, the "natural selection of rules" will explain why we see highly efficient systems of rules of behavior emerging from the myopic actions of people who cannot foresee (or even understand) the consequences of their actions.

The difference between this approach and the standard biological approach to group selection cannot be stressed enough. Standard group selection models are usually focused on situation in which there is only one rule (e.g.: "refrain from proliferating too much", "cry aloud if you see a predator to warn your fellows") and each individual might either follow or infringe it. Groups of followers (altruists) are assumed to have a higher average fitness than groups of non-followers, although, within each group, non followers have higher fitness than followers. The selection process at group level is invoked to explain the emergence of the group beneficial behavior, despite the strong incentive to free-ride in the intra-group interactions.

On the contrary, Hayek's cultural evolutionism only applies when there is a large number of alternative rules (for example private property vs. common property), only a few of which lead to the formation of an efficient order at group level. In this case, group selection "chooses" those groups which stumbled on the "right" rules, that is those rules that favor the emergence of an efficient (or simply viable) social cooperation. Notice that the emphasis here is not on the alternative conformism vs. non conformism. Group selection does not select groups of conformers to a socially beneficial (and individually harmful) rule, against groups of non conformers. Rather, it selects group of conformers to efficient rules against groups of conformers to other, less efficient, alternatives.

4. Hayek's cultural evolutionism and the free-rider problem.

So far I provided a reconstruction of Hayek's cultural evolutionism that gives the free-rider problem a much less prominent role than group selection theory. This could be a consequence of the much lamented insufficiency of Hayek's treatment of the problems

created by the conflict between individual and group's interests, and his focus on coordination, rather than cooperation, problems (Bianchi, 1994). However, there is plenty of textual evidence that Hayek didn't overlook the free-rider problem altogether, and that he proposed an interesting solution to it. Obviously, it would be foolish to expect Hayek's discussion to be as sophisticated as it could have been had him used modern game theoretical models. Despite that, the following passage clearly shows that he elaborated a reasonably clear taxonomy of the kinds of rules of behavior, and that he clearly understood the problems raised by the conflict between individual and group's interest.

> The question which is of central importance as much for social theory as for social policy is thus what properties the rules must possess so that the separate actions of the individuals will produce an overall order. Some such rules all individuals of a society will obey because of the similar manner in which their environment represents itself in their minds. Others they will follow spontaneously because they will be part of their common cultural tradition. But there will be still others which they may have to be made to obey, since, although it would be in the interest of each to disregard them, the overall order on which the success of their actions depends will arise only if these rules are generally followed. (Hayek, 1973: 45.)

Here Hayek classifies social norms under three different headings. First, there are norms followed by everyone because everyone faces similar circumstances. Daily tooth brushing is an apt example. Hayek's example, which I think is misleading, is profit maximization. In current literature, these are typically regarded as non-social norms (see Elster, 1989). Second, other norms are followed by every individual because all her peers are following the same rules (in Hayek's words, they are "part of their common cultural tradition"). In the game theoretical parlance, they might be conceived as "conventions" in the sense first introduced by Lewis (1969), i.e. norms that everyone prefers to follow provided that (almost) all the people he interacts with do the same. Driving on the right (left) hand side of the road or using one's own mother tongue are standard examples. Third, some norms create collective action problems: each individual has an incentive to infringe them, however beneficial they might be for the general order of society. Property rights have been a standard example of this kind of rules since Hobbes.

Thus, Hayek clearly understood that rules and institutions which secure the emergence of an overall beneficial order could be not self-enforcing. However, he didn't seek the solution to this problem in a disposition to abide to the prevailing norms of the group that was shaped by group selection. He clearly states that the solution to the collective action

problem is to be found in punishment strategies implemented (a) by other members of the group when the group is sufficiently small, (b) by a specialized agency (such as a police force) in more extended groups. In other words, individuals refrain from free-riding because they fear their fellows' retaliation and not because they are *altruists* in technical sense.[5] For example he writes:

> A few observations may be added [...] on certain peculiarities of social orders which rest on learnt (culturally transmitted) rules in addition to the innate (genetically transmitted) ones. Such rules will be presumably be less strictly observed and it will need some continuous outside pressure to secure that individuals will continue to observe them. This will in part be effected if behavior according to the rules serves as a sort of mark of recognition of membership of the group. If deviant behavior results in non-acceptance by the other members of the group, and observance of the rules is a condition of successful co-operation with them, an effective pressure for the preservation of an established set of rules will be maintained. Expulsion from the group is probably the earliest and most effective sanction or 'punishment' which secures conformity, first by mere actual elimination from the group of the individuals who do not conform while later, in higher states of intellectual development, the fear of expulsion may act as a deterrent. (Hayek, 1967: 78.)

The upshot of this line of reasoning is that the standard argument against group selection based on the free-ride problem cuts no ice against Hayek's theory of cultural evolution, because he did not conceive group selection as a "solution" to collective action problems in the first place. In Hayek's approach, group selection explains why certain rules of behavior survived while others disappeared in terms of their contribution to the creation and maintenance of a viable social order. It does not explain why individuals conform to the norms that prevail in the group they belong to. The explanation for individual conformism is either the benefits of coordination (in the case of self-enforcing rules) or peer pressure and retaliation.

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[5] Here are some other formulations of this point of view: "[w]e are interested in any rules which are honoured in action and not only in rules enforced by an organisation created for that purpose. It is the factual observance of the rules which is the condition for the formation of an order of actions; whether they need to be enforced or how they are enforced is of secondary interest. [...] [I]f society is to persist it will have to develop some methods of effectively teaching and often also [...] of enforcing them." (Hayek, 1973: 96) "All morals rest on the different esteem in which different persons are held by their fellows according to their conforming to accepted moral standards. [...] Like all rules of conduct prevailing in a society, and the observance of which makes an individual a member of the society, their acceptance demands equal application to all. This involves that morals are preserved by discriminating between people who observe them and those who do not. [...] I doubt whether any moral rule could be preserved without the exclusion of those who regularly infringe it from decent company - and even without people not allowing their children to

Let me briefly recapitulate the conclusions reached so far. In the first place, Hayek distinguishes between two fundamental kinds of social norms: self-enforcing norms and norms that are open to free-riding. In both cases, each norm (e.g. private property) has a (possibly large) set of alternatives (e.g. several forms of common property). Those norms will usually differ in the efficiency of the order they produce. Cultural group selection explains why sets of norms that bring about efficient social orders have higher chances of being selected than their less efficient counterparts. This holds true both for self-enforcing and for non self-enforcing rules. Self-enforcing rules create much less trouble: Hayek's position is simply that those groups which stumbled on less efficient self-enforcing rules will become extinct in the long run.

From Hayek's point of view, problems created by non self-enforcing rules are only slightly more difficult to solve. We might imagine (although Hayek is quite vague on this point) that since group members can punish any violation of whatever norm is prevailing in the group, free-riding is not a problem. One might think that this begs the point, because in stating that free-riding can be resolved by punishment, Hayek assumes what should be demonstrated.

However, Hayek had a different view. He believed that even if we take for granted that *any* norm could be enforced, it would still remain unexplained why (and if) beneficial norms and institutions will be more likely to be observed than dysfunctional ones. Cultural group selection provides an answer to this second issue. It explains why groups that *enforce* efficient rules thrive whereas other groups (that enforce less efficient rules) become extinct. It follows that, when punishment and retaliation come into the picture, the emergence of rules that are open to free-riding do not require altruism as a stabilizing mechanism anymore than self-enforcing norms do.

5. The Enforcement of Norms

Punishment and retaliation has been usually considered a questionable explanation for the emergence of group beneficial norms, because punishing is itself a costly activity, whose benefits accrue to the whole society (Axelrod, 1986). Social norms that are open to

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mix with those who have bad manners. It is by the separation of groups and their distinctive principles of admission to them that sanctions of moral behaviour operate." (Hayek, 1979: 171.)

free-riding survive only if incentives are given to individuals to punish violators, but this will only create a free-riding problem at a higher level. Hayek's theory seems to incur just in this sort of fallacy. However, contemporary game theoretical models show that this apparently sound argument is flawed.

To make this point, I will follow Witt (2001), who discusses the following version of a Prisoner's Dilemma (PD) game (see also Sethi and Somananthan, 1996 for a slightly more complicated model in the same vein). Two individuals meet and both must choose between a cooperative (*C*) and a non cooperative (*D*) action, not knowing their partner's choice. After the choice is made, and payoff received, both players have the opportunity to punish (*P*) their opponent if she has defected, or accept the result without further ado (*A*). The extended and the normal form of the game are represented in Figure 1 and Figure 2 respectively. Payoffs are assumed to fulfill the usual conditions for a PD: $T > R > P > S$, $(T + P)/2 < R$. C_0 is the cost a defector incurs if he gets punished. I shall assume that $T - C_0 < R$, so that punishment causes a cost severe enough to induce people to cooperate if punishment for non cooperation is sure. C_P is the cost incurred by the punishing individual. To strengthen the model, it could be assumed that $C_P > C_0$, so that the punishing individual incurs a larger cost than the punished one.

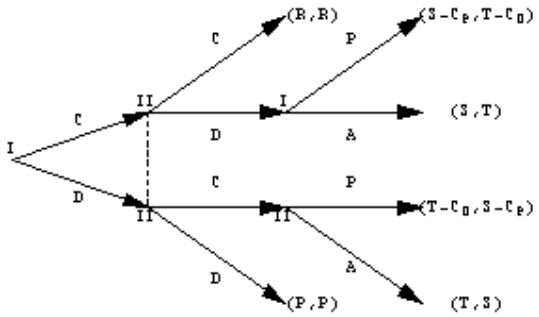

Figure 1

	D	*C/A*	*C/P*
D	*P*	*T*	$T - C_0$
C/A	*S*	*R*	*R*
C/P	$S - C_P$	*R*	*R*

Figure 2

This game has several Nash equilibria. First, there is the pure strategy equilibrium (*D*,*D*), in which both players defect. Second, it has a continuum of mixed-strategies Nash equilibria in which the two players choose a mixed strategy $(0, 1 - p_i, p_i)$ ($i = 1,2$), in which $p_i > p^* = (T - R)/C_0$. In all these equilibria, players cooperate in the first round (so they play *D* with probability 0) and choose at random between punishing and not punishing in the second round. The probability with which they punish must be at least p^* because, as the interested reader can easily verify, if both players punish a non-cooperative behavior with a probability larger than p^*, then cooperating in the first round is the best strategy. Notice that in equilibrium no punishment is carried out, because both players cooperate in the first node.

Standard game theoretical reasoning will exclude that punishment can sustain cooperation in this game. In game theoretical parlance, this game has a single subgame perfect equilibrium (*D*, *D*). To see this, consider that the threat to punish a defection with a probability larger than p^* is not credible: when the last node of the game has been reached, the player who has been cheated will have no reason to carry out his threat, because $S > S - C_p$. So he will play *A* instead of *P*. But since this is common knowledge between the two players, both of them will play *D* in the first node.

Recent literature on evolutionary game theory has cast doubts on the notion of subgame perfection. (See for example Binmore *e. al.* (1995), Binmore and Samuelson (1994)) To see this, suppose that this game is played repeatedly by pairs of individuals drawn at random from a single large population. Let $x = (x_1, x_2, x_3)$ be the state of the population, where x_i represents the fraction of players using strategy i ($\Sigma_i\ x_i = 1$). Suppose that x_1 varies according to the standard replicator dynamics:

$$[1] \qquad \frac{dx_i}{dt} = x_i(\pi_i(x) - \pi(x)),$$

where $\pi_i(x)$ is the payoff strategy i gets when the state of the population is x, while $\pi(x)$ is the average payoff. This amounts to assume that strategies yielding payoff above the average will tend to grow, while the fraction of agents using strategies that yield below average payoffs shrinks. This process might reflect a large variety of different phenomena, from learning from personal experience to imitation of most successful individuals. (See Friedman (1998) and the literautre cited therein for a discussion of the numerous ways in

which the replicator dynamics can be justified in terms of learning and imitation.) In what follows I will assume that the replicator dynamics can be used as a proxy for Hayek's ideas concerning the diffusion of different rules *within a single population*. (In the next section I will show why a single population model is not sufficient to give a full account of Hayek's views concerning cultural evolution.)

The evolution of the three strategies for the game in Figure 2 under the replicator dynamics is depicted in Figure 3 (The parameters are: $T = 10$, $R = 9$, $S = 2$, $P = 3$, $C_0 = 5$, $C_P = 7$).

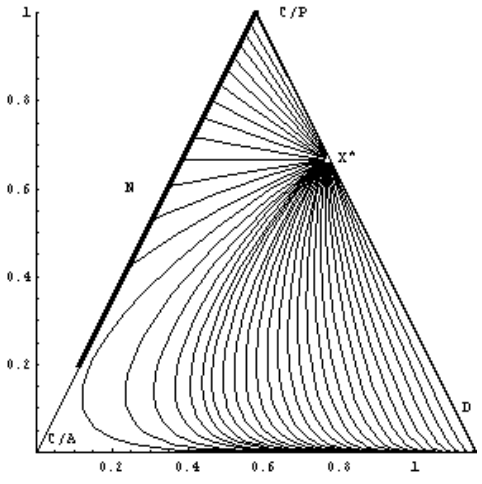

Figure 3

The set $N = [0, p^*]$ represented in Figure 3 is the set of *symmetric* mixed strategy Nash equilibria in which both players play C/P with the same probability $p > p^*$ and C/A with probability $1 - p$.

The strict Nash equilibrium strategy (D,D) corresponds to an asymptotically stable state under replicator dynamics. However, also any point in the set N is stable (although not asymptotically stable) under replicator dynamics. This means that orbits starting in a neighborhood of any state x within N, remain close to x. (See Sethi and Somanathan, 1996 for a formal discussion of this example.)

It is a consequence of this model that a population of myopic players might converge to a state in which nobody defects ($x_1 = 0$) and there is a fraction $x_3 > p^*$ of aggressive cooperators that are ready to punish any defection. The reason why individuals who are ready to carry over costly retaliation do not disappear is that (in equilibrium) there are not

around people to punish. When the norm is generally followed (because everybody plays *C* in the first node), aggressive cooperators playing *C*/*P* and weak cooperators playing *C*/*A* get approximately the same payoff. The selection pressure against retaliators becomes vanishing small when defectors get close to extinction.

This model shows that social norms that are open to free-riding can be sustained through the threat of punishment and retaliation even when reputation effects are absent, which is the typical case of large and anonymous societies. Hence, Hayek's approach to the emergence of norms is not at odds with contemporary speculations that are based on game theoretical models, such as Hirshleifer (1987), Axelrod (1986), Binmore *e. al.* (1995), Binmore and Samuelson (1994).

Notice that so far we made no reference to group selection. What this model shows is that, within a single population, group beneficial norms that are open to free-riding can emerge and remain stable, provided they are sustained by punishment. This confirms our original claim that, in Hayek's perspective, individual's compliance with existing (beneficial) norms does not require group selection.

However, some readers are likely to wonder whether we have proved too much. After all, if the free-rider problem can be solved through punishment (and without selection taking place at group level), what is the use of group selection? The answer is that Hayek was aware of an implication of this line of argument that has attracted far less attention than it deserved. In Section 2 we saw that he believed that punishment can sustain socially beneficial norms as well as socially detrimental ones. In terms of the present model, there is no reason to believe that the same mechanism that stabilizes the socially beneficial cooperation could not stabilize dysfunctional norms just as well. In fact, this intuition too has been largely confirmed by more recent literature. In a paper tellingly titled "Punishment allows the evolution of cooperation (or anything else) in sizable groups", Boyd and Richerdson (1992) show that what they call "moralistic" strategies (that is, cooperative strategies that include costly punishment for non cooperators) "could stabilize any behavior equally well, whether it is beneficial or not. If our conjecture […] is correct, then the dynamics will not be strongly effected by whether or not the sanctioned behavior is group beneficial" (p. 184). Although the details of their model are too complex to be discussed here, the intuition behind their conclusion is obvious. If you get punished for not

conforming to a norm (and the punishment is severe enough) then you had better to conform to that norm, no matter what its effects at aggregate level might be.

The connections with the group selection debate are obvious, and have been stressed by Boyd and Richerson in a more recent paper. In their view,

> the *persistence* of group beneficial norms is easily explained. When people interact repeatedly, behavior can be rewarded or punished, and such incentives can stabilize almost any behavior […] We can be punished if we lie or steal, but we can also be punished if we fail to wear a tie or refuse to eat the brains of dead relatives. Thus, we need an explanation for why populations should be more likely to wind up at a group beneficial equilibrium than one of the vastly greater number of stable but non-group beneficial equilibria (Boyd and Richerdson, 2002: 288)

This passage seems to be taken verbatim from Hayek's works.[6] If my account of his theory of group selection is correct, instead of being a laggard who flirted with dubious and out-of-date scientific concepts, today Hayek would be at the cutting hedge of the research on cultural evolution.

6. The Selection of Norms

Even if we take it for granted that all norms correspond to (possibly unstable) Nash equilibria, and therefore we accept the rebuttal of the free-rider objection provided in the previous sections, Hayek's thesis that most efficient norms tend to be selected seems to be undermined by the growing literature on coordination failures. This literature has shown that limitedly rational individuals might fail to coordinate on efficient Nash equilibria even in very simple games. Take for example the game in Figure 4. The two players involved can follow two alternative social conventions, S_1 and S_2. They can be different forms of property rights (private property vs. common property) different ways of dividing the revenues of hunting (equal sharing vs. sharing according to contribution) and so on.

The literature on coordination failures shows that a population of myopic players could get stuck in the "bad" equilibrium in which everybody plays the inefficient convention S_1.

[6] Beside the quotations in Section 4 above, see for example the following passage: "Morals, to be viable, must satisfy certain requirements which we may not be able to specify but may only be able to find out by trial and error. What is required is not merely consistency, or compatibility of the rules as well as the acts demanded by them. A system of morals also must produce a functioning order, capable of maintaining the apparatus of civilization it presupposes. We are not familiar with the concept of non-viable systems of morals and certainly cannot observe them anywhere in practice since societies which try them rapidly disappear". (Hayek, 1976: 98)

Several authors have taken these results as a final proof that Hayek's optimism about the natural selection of rules is unwarranted. Discussing Hayek's theory of cultural evolution, Sugden (1993: 400) writes that "even if we confine our attention to rules of conduct that provide no opportunities for free riding – to rules that are evolutionarily stable, or strict Nash equilibria – it is not clear that the evolutionary process will favor those rules that are most beneficial at group level. […] The QWERTY keyboard is a paradigm case."

	S_1	S_2
S_1	*2, 2*	*0, 0*
S_2	*0, 0*	*3, 3*

Figure 4

However, the large part of the literature on equilibrium selection in evolutionary games offers a questionable starting point to discuss Hayek's approach to the emergence of the norms, because these models are mostly based on a single population whose members are randomly matched. (For textbook treatments of these models see Weibull, 1995) These models are clearly not the right choice to represent Hayek's thesis that cultural evolution is a by-product of "continued trial and error, constant 'experimentation' in arenas wherein different orders contended" (Hayek, 1988: 20). After all, where there is just one group, there cannot be group selection.

One has then to turn to more complex models, in which agents interact within relatively isolated groups. In recent years quite a few of these models have been proposed, and they all lend support to Hayek's views on cultural group selection. For the reader's convenience I will present here a highly simplified version of a model that has been discussed in several guises in the recent literature. It's most direct source of inspiration is Dieckmann (1999), although similar models are also discussed in Ely (1996), Mailath, Samuelson and Shaked (2001), Bhaskar and Vega-Redondo (2002). The interested reader is to refer to the original papers for the technical details.

There are N individuals living in two separated islands, A and B. N_A individuals live on island A and N_B live on B ($N_A + N_B = N$). Each agent is repeatedly matched with opponents taken randomly from his own island to play a round of the game in Figure 4. Within each island, the fraction of players using the two strategies changes over time according to the replicator dynamics [1]. This implies that the strategy that yields larger payoff within an island displaces the other, *within that island*.

Periodically, small groups of players drawn at random from both populations are given the opportunity to change island. Agents living in the island where the average payoff is smaller will migrate to the island were the average payoff is larger, but not vice versa. Once arrived in the new island, newcomers will immediately adopt the strategy that yields the largest payoff in their new location. If the average payoff is the same in both islands, agents will decide at random whether to stay in their original location or to migrate. Finally, agents living alone in one island get a payoff smaller than the smaller payoff in the stage game, so that they will move towards one populated island as soon as their are given the chance to. If one of the two islands is deserted, nobody will go to live there.

An equilibrium for this model is a distribution of agents between the two islands, and a distribution of strategies within each island, that does not change over time. One can easily see that there are only two such equilibria. In both equilibria only one island is occupied and everybody uses the same strategy, either S_1 or S_2. To see this, consider first that each island can only be in equilibrium if all individuals adopt the same strategy within that island. Similarly, the situation in which both islands are occupied and the two populations follow different conventions cannot be an equilibrium, because people living in the island in which the less efficient convention S_2 is dominant will migrate towards the other island. The situation in which both island are occupied and the same convention prevails in both cannot be an equilibrium either, because players would get the same payoff and therefore will continuously migrate from *A* to *B* and vice versa. Although these random migrations cancel out in the short run, sooner or later one of the two islands will remain without inhabitants. When one of the two islands remains without inhabitants, migrations cease because we assume that nobody wants to live in a deserted island.

So far we have no reason to believe that in the only inhabited island the prevailing convention will be the efficient one. As a matter of fact, if only one island is inhabited, and everybody in that island follows S_2, nobody has any interest either to change her strategy remaining on the same island, or to migrate on the other island.

However, suppose that the model is subject to external shocks due to agents making mistakes in choosing their strategies and their locations. Periodically, instead of choosing the island with the highest average payoff, players will choose the other island. No matter

how rare these mistakes are, their effect on the aggregate dynamics is striking.[7] To see this, suppose that the population is stuck into the suboptimal equilibrium in which only island *A* is occupied and all agents are playing S_2. Suppose now that (by mistake) two individuals migrate towards island *B and* switch to S_1. (Notice that this is a mistake because when only one island is occupied, individuals have no reason to move to the other island.) While agents living at *A* get an average payoff *2*, the two agents living at *B* get an average payoff *3*. All agents who will get an opportunity to migrate will then leave *A* and reach *B*. Sooner or later only *B* will be inhabited by agents using the efficient convention S_1.

This model shows that a very small amount of noise due to individual mistakes can upset the inefficient equilibrium in which the "bad" convention S_2 is selected. Some readers might suspect that a similar argument can be used to show that also the efficient equilibrium can be undermined by individual mistakes, but this would be incorrect. Suppose that when only island *B* is inhabited by people using S_1, a pair of agents will (by mistake) reach island *A* and play S_2. They would get an average payoff 2, and therefore they will fail to attract migrants from island *B,* where the average payoff is 3. As a matter of fact, they will get back to island *B* as soon as they will get the chance to.

This is just a toy model that abstracts from most of the details of any real process of equilibrium selection involving several populations. However, Ely (1996) and Dieckmann (1999) show that it can be generalized in several ways. For example, one would get a similar result relaxing the assumption that newcomers in a population adopt immediately the convention followed in their new location. Similarly, the same result obtains if one incorporates the hypothesis that individuals are imperfectly informed about the average payoffs at the other island.

What is more interesting, however, is that similar results have been obtained in other contexts through mechanisms that do not involve migration. For example, Boyd and Richerdson (1990), Robson (1990), Canals and Vega-Redondo (1998) present models in which interactions take place within partially isolated groups, and assume that groups can become extinct. The chances of extinction are assumed to be inversely related to the

[7] The idea that a small amount of noise can change radically the outcome of the evolutionary process was pioneered in the economic literature by Kandori, Mailath and Rob (1993). Now it is a standard tool to address the equilibrium selection problem in evolutionary games. Young (1998) provides the most organic treatment of the emergence of social conventions based on this approach.

average fitness within the group, so that groups with higher average fitness will have less chances of becoming extinct. They show that in the long run only the most efficient conventions will be observed, because only the groups that selected efficient equilibria survive. Again, this result can be generalized to include some further elements such as inter group random migration.

Hayek's cultural evolutionism could be criticized for being too vague about the process through which group selection operates. In Section 2 we saw that he believed that wealthier (and more populous) societies usually displace poorer societies through warfare or because of their higher growth rate. However, sometimes he seems to believe that wealthier societies will attract migrants from neighboring poorer societies.[8] Still in other places he maintains that norms and habits followed within successful groups are likely to be imitated by social innovators in less successful ones, who will contribute to spread them.[9] An unsympathetic reader is likely to conclude that Hayek has been sloppy about the details of his theory of cultural evolution. A more friendly reading would suggest that Hayek believed that a host of different mechanisms could explain the emergence of more efficient norms and institutions through a selection process operating at group level. The current literature on the emergence of norms suggests that the second reading is probably the most appropriate.

7. Conclusions

Recent game theoretical models show that the standard criticisms to Hayek's cultural evolutionism based on the incompatibility between group selection and the individualistic approach to social sciences are to be revised. Once we recognize, as Hayek did, that altruism is not the only possible *explanandum* phenomenon for a group selection model, we are bound to admit that there is plenty of room for individualistic group selection models,

[8] For example, he says that certain rules spread "because some practices enhanced the prosperity of certain groups and lead to their expansion, perhaps less by more rapid procreation than by attraction of outsiders" (Hayek, 1979: 159)

[9] "Most of these steps in the evolution of culture were made possible by some individuals breaking some traditional rules and practicing new forms of conduct – not because they understand them to be better, but because the groups which acted on them prospered more than others and grew." (Hayek, 1979: 161.)

and hence that Hayek's thesis about cultural evolution is consistent with the individualistic thrust of his philosophy.[10]

To close this article, let me briefly state what the arguments developed so far do and *do not* imply. To begin with, nothing I've said so far implies that social institutions, included those shaped by group selection, are "perfect" so that there is no need for institutional criticism and reform. To begin with, social and institutional evolution is made possible by a continuous stream of innovations. There would be no institutional or cultural evolution if individuals never changed their behavior and challenge existing norms. A careful reading of Hayek's works shows that he provided plenty of room for such innovation and experimentation (see for example Whitman, 1998).

On the other hand, the thesis that a large part of economic and social institutions have been shaped by selection processes operating at group level is perfectly compatible with the idea that some of them are irrational and dysfunctional. Even those who believe that most evolution is driven by selection processes operating at individual (or gene) level are not bound to hold the naïve belief that *all* individual traits are perfect adaptations to the existing environments. In general, to believe that trait *Y* has been shaped by a selection process operating at level *X* does not imply that *Y* is "perfect" at level *X*.

Second, and most important, I'm not suggesting that Hayek was right in claiming (as he did) that group selection has been the unique propellant for cultural and institutional evolution. The models discussed above cannot be taken as a proof that *all* social norms and institutions emerged because they conferred advantages to groups adopting them. It would be foolish to look for an explanation based on group selection for *any* social convention. This would require, for example, looking for a group selection explanation of the fact that British motorists drive on the left hand side of the road, whereas in Continental Europe the opposite convention is followed. Even those who endorse the use of group selection models in the social sciences should be ready to admit that many (or even most) social

[10] Experts in evolutionary game theory will probably object that the models presented in Section 5 and 6 are not entirely consistent one with the other, as the first is based on deterministic replicator dynamic, while the second is a stochastic model. My answer to this criticism is that we still lack a general model of norm enforcement (similar to the one presented in Section 5) in the context of local interaction, be it stochastic or deterministic. While local interaction models have been widely studied in the context of coordination games (i.e. games with multiple *strict* Nash equilibria) to my knowledge they have never been investigated in more

conventions are just historical accidents, whose only explanation is to be found in the peculiarities of the historical developments of each society. Hayek has never paid attention to the purely conventional character of social norms and institutions, and this is one the weakest point of his evolutionary approach.

What we have learned from the recent developments on cultural evolution, however, is that sensible group selection models can be constructed and that they cannot be dismissed as utterly unrealistic on *a priori* ground. For example, they are not necessarily more unrealistic than the single population models that have frequently been taken as a proof that Hayek was wrong on group selection.

An important implication of this result is that instead of discussing to what extent group selection is theoretically compatible with the individualistic approach to the social sciences (because it obviously is), we should discuss to what extent group selection models allow for a better understanding of social norms and institutions. In turn, this requires a long a careful empirical work, which is still in its infancy (see Soltis, Boyd and Richerson, 1995). Hayek should be criticized for having been too hasty in his conclusion that group selection was *the only* mechanism to explain the emergence of the norms that make a workable social order possible. What this paper has tried to show is that this criticism should concern the empirical side of his work. As far as we can see today, the theory is mostly correct.

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complex games like the one discussed in Section 5. Of course, this would be an interesting point of departure for future research, which, once again, shows how fertile Hayek's intuitions can be.

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