Reports

Social Markers and the Evolution of Reciprocal Exchange[1]

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> *In primitive or archaic types of society, what is the principle whereby the gift received has to be repaid? What force is there in the thing given which compels the recipient to make a return?*
> MARCEL MAUSS, *The Gift*

Humans are remarkable within the animal kingdom for the extent to which they become involved in cooperative exchange. Although it is organised in different ways in different societies, exchange is a universal human activity (Davis 1992). It is partly a material phenomenon; in all societies, people promote their social and economic interests by means of trade, sharing, gifts, loans, and mutual aid. There is also a non-material dimension. Natural language is a specialised system for the transmission of propositional information. It is infinitely open-ended: using recursion and duality of patterning, an infinite number of messages can be generated. Thus humans have a unique adaptation for the generalised, usually cooperative exchange of information between individuals. It is clear that such an adaptation is made possible only by the existence of sizeable, enduring, cooperating groups.

Most anthropologists take the human propensity to form groups based on cooperative exchange as a theoretical primitive. Groups of this kind do indeed seem to be an integral and fundamental part of human social structure. However, this raises the question how they first arose. We neither observe them in our nearest animal relatives nor particularly expect them on the basis of natural selection, which operates on individuals' genes rather than groups or species. Simply to posit ul-

trasociality as human nature is intellectually unsatisfying, and whilst we agree that the outcome of human social evolution is a type of group radically unlike those of other animals, we see no reason that the mechanisms governing that evolution—chiefly natural selection—should be any different. To that end we have examined the evolutionary bases of cooperation and exchange.

If exchange involved a direct and immediate payback, its evolution would be easy to explain. However, this is not the case. It is characteristically delayed and indirect. The !Kung San hunter-gatherers give us an archetype of such generalised reciprocity. Although they spend much of their time in small, kin-based bands, they regard these as "mere temporal manifestations of a much larger group" (Wiessner 1977:xix). Thus the San family "surrounds itself with a community of others who will give assistance of any kind as they can, and place no demands on amount or timing of return except that in a reversed situation of have and have not, a return will be made" (p. 98). Similarly, Braun and Plog (1982:507) describe "tribal" social networks as "lines of transmission of material and information through reciprocity and reciprocal roles."

The selective advantage of such cooperation is often taken as self-evident in discussions of the evolution of language and culture: "[there is] an obvious advantage to being able to acquire . . . information secondhand: by tapping in to the vast reservoir of knowledge accumulated by other individuals, one can avoid having to duplicate the possibly time-consuming and dangerous trial-and-error process that won that knowledge" (Pinker and Bloom 1990:712). Bickerton (1990:147) writes in a similar vein: "There is, however, an advantage in being able to exchange a mere handful of words. You can warn of danger or pass on information about food sources—actions that might help preserve the lives of individuals or even whole groups."

However, it is one thing to point out how useful an evolutionary development would be; it is quite another to show that it is in fact an evolutionarily stable strategy. Many accounts of the evolution of society seem either to incorporate a group-selection position (as in the Bickerton quotation above) or to be too sanguine about the potential of cooperation as an evolutionary strategy, for whilst there is an obvious advantage in acquiring the fruits of exchange, it is not always advantageous to give them away. In fact, cooperation is likely to be viable only where there is relatedness or guaranteed reciprocity between individuals.

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Because related animals share a portion of their genotype, they have an intrinsic interest in each other's survival. Much animal cooperation can be shown to be kin-directed. For example, the code used by bees (Von Frisch 1967) to signal the whereabouts of food is used between closely related individuals. The predator alarm calling of prairie dogs is performed by individuals with kin in the group (Hoogland 1983). Much human exchange does go on in small networks based on kinship, but as we have seen, even in small-scale hunter-gatherer societies much larger, weakly cooperating groups are also to be found. An evolutionary basis for these must be sought outside kin selection.

Cooperation can emerge in a population of unrelated individuals where there is a possibility of reciprocity (Axelrod 1984). However, it is viable in fitness terms for individual A to help individual B only if there is a high likelihood of A's meeting B again in the future, giving B the opportunity to reciprocate. This continuity is essential in securing cooperative social relations.

As the size of the interacting group increases, the establishment of cooperation becomes more difficult (Boyd and Richerson 1988, 1989). This is because individuals can achieve higher payoffs by just taking and not giving. Moralistic punishment of cheats can make cooperation more stable (Boyd and Richerson 1992). However, where individuals are highly mobile, this is unlikely to be successful, and cooperation is problematic (Enquist and Leimar 1993), as cheats, known as free riders, can go from victim to victim exploiting each and then moving on before their debt is called in. Thus the evolution of reciprocal relations in such mobile and dispersed groups as the San would seem difficult to account for.

However, generalised reciprocity is not usually indiscriminate. It is strongest with close associates and kin and otherwise preferentially directed to those perceived to be within the same wider social formation (Sahlins 1972). The !Kung, for example, form gift exchange networks with other !Kung bands, but "people, even San, of a different language group . . . are foreign people and to be regarded with suspicion" (Wiessner 1977:xix). Thus, the language serves as an important index of social allegiances, and this indexing could well be important in the maintenance of group cohesion.

One of the most striking facts about language is its variety. An individual's knowledge of language is thus an interaction of biological abilities and cultural institutions. Diversity is generally ignored in discussions of the evolution of language; the identity of the underlying mental structures is considered more important than superficial differences in realisation. However, the obvious question is why, if language is a basically innate ability, there should be a locus for cultural variability at all. Why should so much of the surface form of language be acquired from the environment, and why should that environment have come to be so different the world over?

Pinker and Bloom (1990) have addressed this question. First, they explain, to represent a complete language,

including all the words, genetically might consume excessive genotypic space. Secondly, as the language faculty must be expected to change by genetic drift, an individual with an innate language might fall out of step with his peers. It would thus be advantageous to have a code with developmental flexibility to home in on that spoken in the group. Thirdly, as Hinton and Nowlan (1987) find, once most of a trait is determined genetically, selective pressure to represent the rest in the genotype declines, because learning can be relied on to fill it in. Divergence, it is argued, arises as an accidental consequence of the genetic underspecification of language.

These factors may well have been important in the evolution of language, but we should not overlook the social use to which linguistic variability is put. Individuals do not just learn any language; they "construct their system of verbal behaviour to resemble that common to the group or groups with which [they] wish from time to time to be identified" (LePage 1968:192). Labov's sociolinguistic studies (Labov 1963, 1972) have demonstrated not only that the adoption of linguistic variables correlates with membership of a social group but that when a group feels itself threatened by outsiders, it will increase its usage of the linguistic markers that make it distinctive, thus producing divergence over time. The effect can be reproduced experimentally at the individual level. Bourhis and Giles (1977) constructed a study in which Welsh-speakers were challenged by an aggressive English experimenter. The subjects were observed to broaden their Welsh accents and even to start switching into the Welsh language. Similarly, during a positive interaction, speakers will quite automatically accommodate their way of speaking to that of their interlocutors (Giles and Smith 1979). It is easy to see how accommodation to group members and discommodation from non-members, if sustained and not balanced by positive intergroup contact, would ultimately lead to the existence of separate languages. Consciously articulated strategies of linguistic purism, linked to nationalist sentiment, also play an important role in the development of languages (Thomas 1991), and people generally have strong and often irrational normative feelings about their language.

Sociolinguistics has been able to show the extent to which linguistic variables carry social-indexical information, but just what this information is used for has been less well studied. When asked to assess strangers on the basis of speech, subjects from several cultures have been shown to rate their own speech variety higher than others on scales of solidarity, such as friendliness and helpfulness, though not necessarily on scales of social status or ability (Giles and Powesland 1975). The continued existence of low-prestige varieties (Bouchard-Ryan 1979), and the tendency of social climbers to switch back to the vernacular at key moments on return to the home community (Blom and Gumperz 1972) have thus been explained on the basis of the need to invoke the solidarity of the "local team." There is evidence that such an invocation can be effective. Gaertner and Bick-

man (1971), Giles, Baker, and Fielding (1975), Feldman (1968), and Harris and Bardin (1972) have all shown in various contexts that use of a highly valued speech variety greatly increases success in obtaining cooperation from strangers. Similarly, teachers and employers have been shown to be more favourably disposed to speakers of valued norms. In economic terms, having the wrong dialect seems to increase the cost of cooperating with someone (Lang 1992).

Thus it seems that access to cooperation can depend on the use of the right linguistic markers. This social-indexical role may be a function of language of some evolutionary importance. As Chambers (1995:208, 250) puts it, "The fact that linguistic variability is universal and ubiquitous suggests strongly that it is fulfilling some essential human need. . . . The underlying cause of sociolinguistic differences . . . is the human instinct to establish and maintain social identity." The rest of this report uses computer simulation to examine the way in which dialects might be used to mark membership of a social group and how this might affect the stability of reciprocal exchange between non-kin in a notional population.

METHODS

In this simulation, 100 organisms are situated at 100 different positions in a linear environment. In each cycle of the simulation, each one encounters another one. Which one they meet is determined randomly, but the farther apart the initial positions of two organisms are, the less likely it is that they will meet. The probability of meeting organisms from different initial distances away at a given moment is shown in figure 1. Each organism has a "dialect" made up of a string of six numbers, initially 1, 2, 3, 4, 5, and 6.

The organisms have a level of wealth, which starts at 50. When they meet, they may enter into an exchange by giving a gift. It costs them 1 unit of wealth, but it is
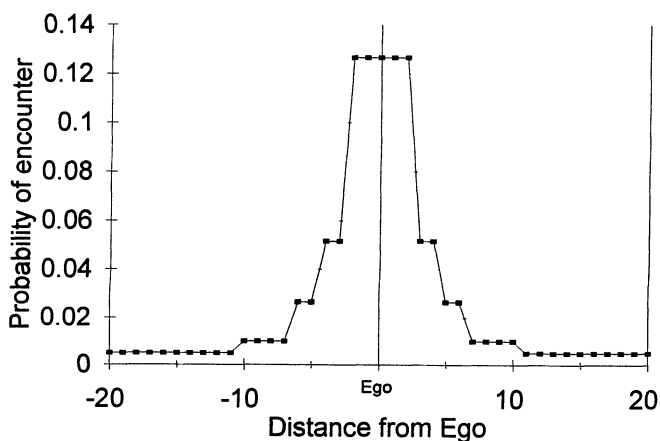
TABLE 1
The Payoffs for Gift Exchange (Payoffs for Ego Given First)

	Alter	
Ego	Give	Does not give
Give	1, 1	-1, 2
Does not give	2, -1	0, 0

worth 2 units of wealth to the recipient. This asymmetry has been included to make exchange an economically favourable option within the simulation. It reflects the fact that people may give away what they have a surfeit of and receive that which they lack. The same gift goods may thus have a higher value to the recipient than to the giver. The asymmetry precisely mirrors the fitness consequences of exchange: a given unit of surplus wealth will have a minimal impact on the fitness of the giver but may have a considerable impact on the fitness of the recipient.

The payoffs for gift giving constitute a classic game known as the prisoner's dilemma, which has been studied in some detail by economists and evolutionary biologists (table 1). In this game, the highest payoff is for receiving a gift and never paying it back. The next-highest is for reciprocal giving. Nothing is gained or lost from neither giving nor receiving, and giving and not receiving leads to an actual loss. Of course, it is not necessary to receive from the particular individuals to whom one gives; it is sufficient to receive in total as many gifts as one gives out.

At the end of each cycle, the wealth of each organism is changed by a random amount between plus and minus 4. This reflects seasonal and random fluctuations in the supply of resources.

The organisms have been equipped with a very limited cognitive capacity. They can simply remember whom they met and whether they gave and were given a gift for a specified number of cycles which can be varied (the MEMORYSPAN). MEMORYSPAN is set at 5 unless otherwise stated, thus making it impossible for organisms to keep track of all the others they are likely to come across, who number up to 40 (see fig. 1).

At the end of a specified number of cycles (the LIFETIME), a generation is said to have passed. Each of 20 organisms with the highest wealth levels is given a 0.5 probability of reproducing—that is, putting another organism of the same type as itself in the next generation. When they have reproduced, the same number of organisms die off. These are chosen at random from the 20 with the lowest wealth levels. The initial positions of the different organisms in space are determined randomly. Thus organisms have no better than chance probability of being near to others similar in type to themselves.

FIG. 1. *The probability of meeting another organism from different initial distances from Ego in a given encounter.*

There are four types of organism, each with a different exchange strategy. The first type, COOP, always gives when it meets another, unless it can remember giving and not receiving in an encounter with that particular individual. It thus follows a tit-for-tat strategy of the kind which is highly effective in organisms that can reliably recognise each other.

The second type, CHEAT, never gives to anyone. It is thus likely to exploit COOPs which fail to recognise it or which it has not met before, moving between them as a free rider.

With the third type of organism, dialects come into play. POLYGLOT gives gifts only if the recipient has a nearly identical dialect (five or six of the six numbers specifying the dialect being the same). When POLYGLOT receives a gift, it changes its dialect to that of its benefactor. In addition, at each exchange, a POLYGLOT may change one of the six numbers in its dialect to a random value between 1 and 50. The probability of this happening, the CHANGERATE, can be varied but is usually 1%. POLYGLOT thus both acquires the dialect of its allies and innovates dialectal changes.

The fourth type of organism, MIMIC, is a free rider like CHEAT. However, it too changes its dialect to be like that of its benefactor when it receives a gift.

The key questions for the simulation are, first, whether COOP is stable against CHEAT, given the degree of mobility the organisms have, and whether varying MEMORYSPAN has any effect on this; secondly, whether POLYGLOT's use of "sociolinguistic" markers make it any more successful against CHEAT; and, thirdly, whether these markers are useful against a free rider which MIMICs them.

RESULTS

A population of all COOPs does very well. The wealth of all is increased through exchange. However, if five copies of CHEAT are introduced, with MEMORYSPAN set at 5, the CHEATs always invade rapidly (fig. 2). This
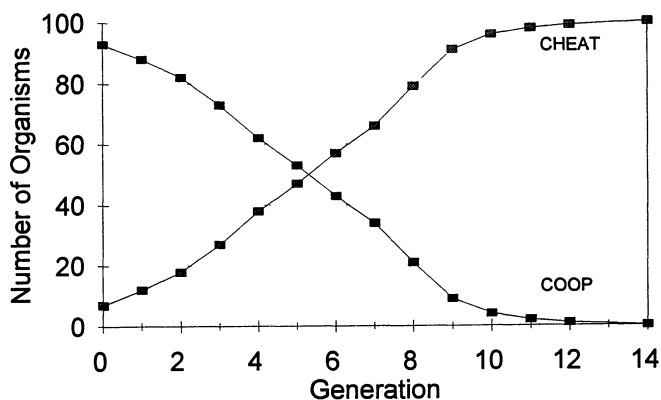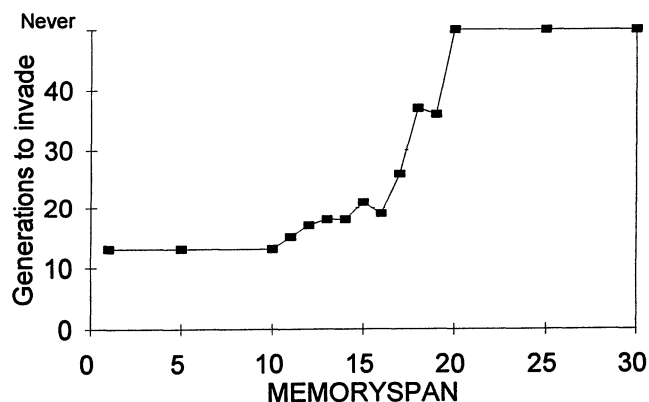
FIG. 3. *The number of generations required for 5 CHEATs to displace 95 COOPs for different values of MEMORYSPAN (LIFESPAN = 200).*

FIG. 2. *An evolving population starting with 95 COOP and 5 CHEAT organisms (LIFESPAN = 200).*

is true for any value of LIFESPAN. In a population of mainly CHEATs, wealth levels are very low, as exchange does not occur. Nonetheless, COOPs cannot break through, for in such a population, however badly the CHEATs do, the COOPs do even worse. As one would expect, indiscriminate cooperation is not viable when mobility is high and MEMORYSPAN is low.

Increasing MEMORYSPAN decreases the CHEATs' advantage by making it more difficult for them to find victims. Figure 3 shows the number of generations required for five CHEATs introduced into a population of COOPs to displace them. It is clear that increasing MEMORYSPAN above 11 seriously impairs the CHEATs' fitness to the extent that, with a span of 20 or more, they actually go extinct themselves. These results support Dunbar's (1993) view that increasing the cognitive capacity of an organism increases the possible size of cooperating groups but indicate that where the size of the total interacting population outstrips the cognitive ability of individuals to know every other one personally, cooperation will be particularly difficult.

When the simulation is run with a population of POLYGLOTs, distinctive dialects gradually emerge in different regions of the space to reflect the paths of exchanges between organisms (table 2). The occurrence of dialect changes is initially completely random, but once changes occur they are used in assessment and therefore differences are reinforced. Organisms in the same dialect group exchange and therefore keep standardising their dialects, while those in different groups cease to exchange and therefore tend to become more and more different. Thus, adjacent POLYGLOT organisms may end up, by historical accident, in different dialect groups, not exchanging when they meet (fig. 4). Exchange need not be direct; if A exchanges with B and then B exchanges with C, dialectal innovations will be transmitted from A to C indirectly, and A and C will then "recognise" each other and exchange when they meet.

TABLE 2

The Dialects of Some POLYGLOT Organisms after a Generation of the Stimulation

Organism #81	Dialect	24	23	27	4	5	13	a
Organism #82	Dialect	27	34	3	22	26	30	b
Organism #83	Dialect	27	34	3	22	26	30	b
Organism #84	Dialect	44	8	23	2	34	7	c
Organism #85	Dialect	44	8	23	2	34	7	c
Organism #86	Dialect	1	2	3	4	5	44	?
Organism #87	Dialect	44	8	23	2	34	7	c
Organism #88	Dialect	44	8	23	2	34	7	c
Organism #89	Dialect	24	23	3	4	5	13	a
Organism #90	Dialect	1	40	3	4	11	5	g
Organism #91	Dialect	33	46	40	4	30	26	d
Organism #92	Dialect	33	46	40	4	30	26	d
Organism #93	Dialect	24	23	3	4	5	13	a
Organism #94	Dialect	41	28	49	5	27	24	e
Organism #95	Dialect	24	23	3	4	5	13	a
Organism #96	Dialect	41	28	49	5	27	24	e
Organism #97	Dialect	1	2	3	16	39	39	f
Organism #98	Dialect	33	46	40	4	30	26	d
Organism #99	Dialect	1	2	3	16	39	39	f

NOTE: A large number of mutually "incomprehensible" dialects have emerged. The group to which each organism belongs is indicated by the lower-case letter at the end of the line. Dialect affiliation is not always based on spatial proximity but depends upon random early encounters. The result may be dialects like *a*, which are widely distributed in the space. Organism #86 has apparently failed to join a dialect group.
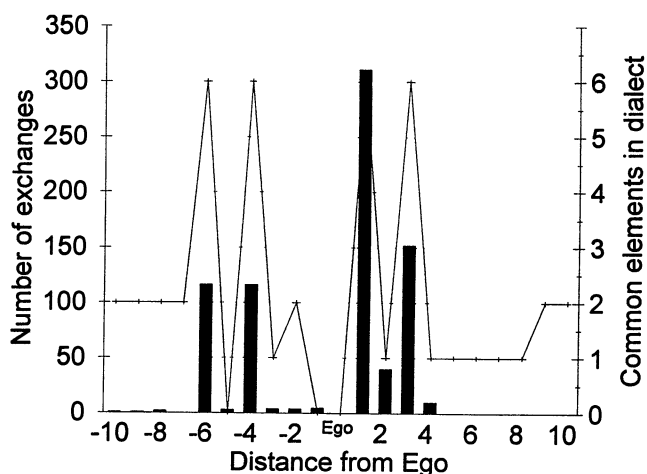

FIG. 5. *An evolving population starting with 5 POLYGLOTs and 95 CHEATs. For the first four generations, the POLYGLOTs are allowed to cluster in one part of the space. Thereafter they are distributed randomly (LIFESPAN = 10,000).*

FIG. 4. *The number of exchanges between a POLYGLOT organism and its neighbours over 2,000 cycles of the simulation (bars), with the degree of dialectal similarity at the end of the run (line). The frequency of exchange is a function of dialectal similarity more than proximity.*
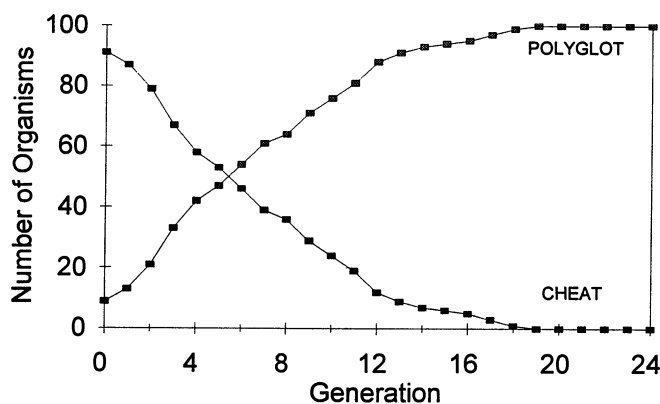
As long as the LIFESPAN is 1,000 cycles or more (with MEMORYSPAN = 5 and CHANGERATE = 1%), POLYGLOT cannot be invaded by CHEAT, as the CHEATs are identifiable by their dialects and are never given anything. The CHEATs have a tremendous advantage in the first few cycles of each generation, before enough dialect changes have occurred to differentiate them. Once distinctive dialects become established, however, they do less and less well, and their wealth levels relative to POLYGLOTs in the same population decline as LIFESPAN increases. However, a small group of POLYGLOTs cannot normally invade a population of CHEATs because, given the random spatial distribution of the organisms, their frequency of meeting each other is too low for distinctive dialect groups to be reliably established. However, 5 POLYGLOTs can invade a population of CHEATs if they are allowed to cluster together in space and produce offspring adjacent to themselves. This protection of the group can be removed once a critical mass of POLYGLOTs has built up, and the POLYGLOTs will go on to replace all the CHEATs (fig. 5). The critical mass is about 55 with LIFESPAN = 1,000 and about 45 with LIFESPAN = 2,000 and declines to about 30 with LIFESPAN = 6,000 and above.

This finding suggests that a social marking system is most likely to become established where groups of like individuals are partially isolated from each other. Indeed, the initial linguistic differences could actually occur by drift and geographical separation and only subsequently be put to use socially. Once established, however, social marking appears to be a stable strategy.

With the parameters set at MEMORYSPAN = 5, CHANGERATE = 1%, and any LIFESPAN, five MIMICs invade a population of POLYGLOTs. They do this simply by learning the particular dialect of some POLYGLOTs close to them and taking from them whenever they meet them. They get nothing from organisms with
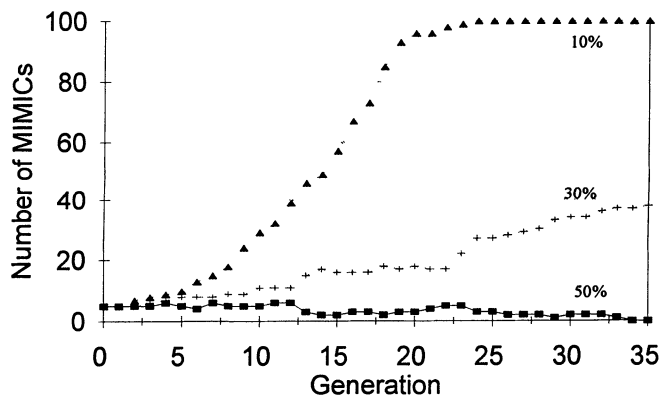
FIG. 6. *The number of MIMICs in an evolving population starting with 95 POLYGLOTs and 5 MIMICs for three separate runs of the simulation: CHANGERATE = 10%, CHANGERATE = 30%, and CHANGERATE = 50% (LIFESPAN = 1,000).*

different dialects, and so their advantage over POLY-GLOTs is much more limited than that of CHEATs over COOPs, but they still displace the POLYGLOTs. However, if the CHANGERATE is greatly increased, MIMIC ceases to be effective. This is because, having taken from a victim, they cannot interact with the same one again for a period determined by MEMORYSPAN. If the dialect of that victim is changing fast enough, then it will be too different after the MEMORYSPAN is up for the MIMIC to take from the POLYGLOT again. The CHANGERATE required for POLYGLOT never to be invaded by MIMIC is about 50% with MEMORYSPAN = 5 and LIFESPAN = 1,000 (fig. 6).

DISCUSSION

These results suggest that producing distinctive codes may be a way that reciprocal exchange in large groups can be made more stable. Admittedly, organisms in our simulation have only limited mobility. However, linguistic diversity may also function to constrain human mobility. The free rider, who is conceived of in many models as a ruthless exploiter of generosity who moves quickly from group to group, could not possibly survive in populations where each local group had its own language or dialect. Each group would be able to tell by his speech that he was an outsider and where he came from. This is not to imply, of course, that social identity is an unchanging, clear-cut matter. In real life, it is always being renegotiated and redefined and loses or gains significance according to the situation at hand. Nor do we mean to suggest that cooperative relations never occur between members of different speech communities. Clearly, they do, but social markers nonetheless give a great deal of honest information about the person with whom one is dealing, and people do use this information in evaluating alternative courses of action.

The current simulation is entirely notional. More realistic assumptions about mobility, cognitive capacity,

group sizes, and dialects would have to be made to demonstrate that the process we describe was important in the development of human societies. However, the simulation does show that cooperation can evolve more easily in a simple system where social marking is present than in one where it is absent, and this, coupled with our knowledge of sociolinguistics, makes it highly plausible that the social marking mechanism has played a role in language evolution.

Many different strategies must have been used to perpetuate cooperation in human history; recent suggestions include gossip and suspiciousness (Enquist and Leimar 1993) and moralistic aggression and punishment (Boyd and Richerson 1989). Social marking may be another part of the picture. Language, of course, is not the only variable which can serve as a social marker. Different styles of material artefacts, dress, and adornment can be adopted for the same reason. However, language is particularly well suited to the task, as it is inseparable from the person and relatively difficult to falsify. Phonetic variables in speech are most informative, as each sound recurs fairly often.

Social marking seems likely to become necessary when the size of the local population exceeds the size of the cooperating group which can be maintained by direct personal acquaintance. Gilman (1984) has specifically argued that the dramatic increase in local variation in material culture found in the Upper Paleolithic is a response to the problem of maintaining "corporate solidarity" in the face of increased population density. Linguistic boundaries may have appeared for the same reason at this time, as group sizes outstripped our ability to keep track of them.

If this argument is correct, our great skill in using and assessing language as a social marker is an adaptive psychological mechanism tied up with the very development of human exchange and communication. The social function of language would therefore be central to its evolution and not marginal as many linguists have assumed. More realistic simulation is needed, but the success of POLYGLOT seems to suggest a reason that, in the words of Davies (1945), "a nation should guard its language more than its territory—'tis a surer barrier, a more important frontier than a fortress or river" (quoted in Giles, Bourhis, and Taylor 1977:326).

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Belief Systems about Virgin Birth: Structure and Mutual Comparability[1]

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Anthropologists have long debated the question how to interpret the beliefs about virgin birth held, for instance, by the Trobrianders and formulated in world religions such as Christianity. In 1990, this problem of interpretation still seemed to be unresolved. In that year Stanley Tambiah asked, "Can we really reduce to a logically testable form what an ordinary Roman Catholic holds about the 'immaculate conception' of Mary or a Trobriand Islander about the male contribution to the conception of babies?" (1990:132). This report advocates an affirmative answer to Tambiah's question. The present analysis follows a line of thought already expressed by Tambiah himself: "One [can] maintain that moral or religious systems address certain universal existential issues and human constraints, and yet hold that the systems in question are in important respects *different* in their emphases, commitments, styles and preferences" (p. 130).

Trobriand Islanders and many peoples in Australia have (had) belief systems in which sexual intercourse is not a sufficient or even a necessary condition for procreation. In such belief systems, an ancestor is generally supposed to introduce the child into the mother. Usually it is necessary for the woman to be deflowered, but according to Trobriand beliefs even this defloration can be established without intercourse (although intercourse is the usual manner).

Whether the belief systems of the Australians and the Trobriand Islanders can be compared to the belief system of the Virgin Birth of Jesus is a question that has attracted considerable interest from the anthropological community since the discussions between Edmund Leach and Melford Spiro in the sixties (especially Leach 1967 and Spiro 1968). Leach claimed that the two belief systems can be compared (1967:42, 44), while Spiro denied this (1968:249). Much confusion in the virgin-birth