CORNELL UNIVERSITY

ON SUCKERS AND SNEAKERS:
AN ECONOMIC ANALYSIS OF
COOPERATIVE AND UNCOOPERATIVE SOCIETIES
IN EVOLUTIONARILY EQUILIBRIUM

A RESEARCH PAPER SUBMITTED TO

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CHAPTER I

INTRODUCTION: ON SUCKERS AND SNEAKERS

During my time as a student in Hong Kong, theft in my high school grew from the occasional stolen wallet to a peak where up to twenty handheld music players and wallets might go missing in a 45 minute window. School administrators concluded that such was clear evidence of organized crime, and in a small school where each grade level did not exceed 130 students, distrust quickly became the prevailing atmosphere.

The average annual family income of the students then, and probably more so now, exceeded well over USD$100,000. These crimes were a result not of need, but rather, of want. While this may be disturbing to the philosopher, a trained economist has no problem with such a result. If we apply the core economic assumptions that all individuals are perfect selfish, and make rational choices based on this selfishness, and that more is preferred over less, we realize that the economic prediction is a perfect reflection of this situation.

While economics may have the right prediction at my high school, it is not always so. A glance at the study lounges in Uris Library at Cornell University will show an example of the exact opposite situation. There is an abundance of laptop computers, cellular phones, and many other valuables left unattended by students. However, the theft rate is relatively low.

We expect that the risk of stealing in my high school given the small population size must have been considerably lower. Also, because laptop computers were not numerous either, the expected payoff for each successful steal must have been similarly lower. Thus the economic incentives to steal are much more prevalent on the Cornell campus but the incidents of such theft are much lower. Clearly there are forces beyond those of traditional economics acting on these individuals.

It is also worthwhile to note that each 'society' is in a stable state. My high school has been fighting theft on campus for many years. As this is only my second year at Cornell, I cannot make the same assertion about Uris library, but I would hypothesize that such an atmosphere of trust does not suddenly come out of nowhere. Thus we can conclude that both societies are more or less in equilibrium.

In recent years we have seen a growing body of literature that studies precisely such social phenomena as the two examples mentioned that classical economics apparently cannot explain. As an optimist I like to believe that in more advanced societies and organizations, instances of the second example are likely to be more numerous. That is to say, that we frequently make decisions that apparently do *not* maximize our level of happiness, or as economists term it, utility. Consider for example, that having an extra laptop would no doubt increase utility, but most individuals do not roam about the library stealing them.

In this paper I seek to answer why we might find some stable societies rife with theft and distrust, while others, equally stable, exhibit the exact opposite traits of trust and cooperation. I will begin by laying down the economic tools that have traditionally been used to explain utility maximization and the incentives it gives us to steal. I will then use game theoretical analysis to explain why cooperative societies such as that observed in Uris library are able to exist in equilibrium. I argue that while the economic principles of demand and supply and profit maximization are certainly present, the forces of social norms and beliefs lead us to make 'sucker' decisions. For the most part, sucker decisions, while individually inefficient, are socially optimal outcomes. Thus, as a society, we have through group selection and meme selection, evolved into a collection of individuals that as a matter of routine, voluntarily make 'sucker' decisions.

However, Kin selection is not perfect, and evenly highly cooperative societies have at least a low level of crime rate. In the same way it is possible for social norms and beliefs to have a positive effect on society, it is also possible for them to have a negative effect on society. In chapter IV, I argue that these are some of the factors that allow societies where theft and distrust prevail to also exist in equilibrium.

Having explained why we find two equilibriums, I then make some observations about the two examples using to Wright's (1932) concept of adaptive landscapes and discuss the difficulties inherent in helping societies at lower fitness peaks ascend to higher fitness peaks.

Being able to identify the causes that lead us to routinely behave at socially optimal level and differentiate them from those that leads us to routinely behave at a socially inefficient level, is important in shaping public policy. Clearly social norms play an crucial role in guiding our decisions, harnessing and manipulating them would be the first step to solving many of the social problems, such as theft, drug abuse, that plague our society today. I want to stress however, that the purpose of this paper is not to create a workable solution but rather to identify the causes and thus provide the groundwork that well enable us to build social programs for the exact purpose of solving these problems.

CHAPTER II

INCENTIVES TO STEAL

In this chapter, I sketch the economic tools used to explain the incentives to steal.

Utility and Rationality

Before I delve into a more formal analysis, let me first briefly review the core economic assumptions of utility and rationality.

Economics is the study of the allocation of scarce resources. We allocate resources based on the value we place on them. Consider a letter from old friend. From a market perspective, the letter is worth nothing more than the letter paper it is written on and the ink used to write it. If however someone offered you $100 to buy the letter off you, if the friend is a dear one, I suspect that many people would be unwilling to sell. Clearly market values in dollar terms do not reflect the ‘true’ value of a good to an individual.

Economists overcome this problem by introducing a concept of utility. Each individual has a utility function, or an equation for happiness. For example, we might expect the following utility function from a college student studying for his exam:

$$E(U) = p_w W - HC$$

Whereby W represents the amount of happiness he expects to gain from a doing well on his exam; p_w represents the probability that he will do well on his exam; H represents the hours spent studying; and c represents the cost, per hour, of not only studying, but also forgoing everything else that he might have been able to do instead, such as watching television or playing sports.

If we expect that the student is a rational individual, his goal will be to maximize his expected utility. We expect that the more he studies, the higher p_w becomes. However, the more he studies, the higher the total cost, HC, of studying becomes. Thus a rational student will strike a balance between work and play.

Perfectly Selfish Players and the Nash Equilibrium in the Prisoner's Dilemma

In "The Wealth of Nations" Smith (1776) proposed the idea of the 'invisible hand.' This mechanism, by which through the perfectly selfish acts of rational individuals resources were allocated to its socially efficient uses, was until recently, widely accepted. However, examples such as the prisoner's dilemma contradict the invisible hand; individuals are less likely to cooperate, and thus often reach less efficient results.

In the prisoner's example, there are two individuals standing trial for a crime. They are interrogated separately and told that if one of them confesses their crimes while the other does not, the one who confesses will walk free while the other will serve a twenty year sentence. If both confess, they will serve a ten year sentence each. If on the other hand, neither confesses, they will serve only three year sentences each. We might illustrate their sentences served in the following matrix:

Prisoner 2

Prisoner 1		A	C
	A	3, 3	20, **0**
	C	**0**, 20	**10**, **10**

A and C represent their decisions to either abstain, or confess respectively. Clearly if the prisoners were able to discuss this together, they would both want to abstain, upon which the judge having inconclusive evidence can only jail them for three years each. However, what also becomes clear that if both prisoners are rational, they will both definitely choose to confess. If prisoner 1 knows the prisoner 2 is going to abstain, then he will choose to confess. If prisoner 1 knows that prisoner 2 is going to confess, he will also choose to confess. Regardless of what the other prisoner does, it is always more lucrative to confess. In short neither prisoner can do better off by unilaterally deviating. The Nash equilibrium[1] is thus that will confess and each will receive ten years in jail. They are both acting in their own interest and as a result, contrary to the invisible hand argument, they are each worse off.

[1] See Nash (1950) "Non-cooperative games."

CHAPTER III

COOPERATIVE SOCIETIES: URIS LIBRARY

In Uris library at Cornell University, I have observed that students often leave their valuables unattended. These valuables are mostly items of high resale value such as cellular phones, music players and laptop computers. It is worth noting that security at the library is also relatively lax; to my knowledge, there is no close circuit television in the study lounges. Furthermore, many students frequent the libraries by themselves, and while there may be many observers, it would be hard to tell if a student was stealing someone else's phone, or merely taking his own outside for a call. From an economic perspective the study lounges in Uris library provides all the incentives to steal. The interesting phenomenon is that while there certainly are reported cases of theft, given the said incentives, the number of cases is negligible.

In this chapter, I will use a modified version of the hunter gatherer game to model the interaction between students studying at the library. I will then use this model to explain why, through group selection and meme selection, in spite of the large incentives to steal, an atmosphere of trust has managed to become the stable norm.

The Library Game

Suppose in a library two students leave their desks at the same time for a study break. We assume that the two students have with them valuables of equal worth. We also assume that the student prefers to leave his valuables, but in leaving his valuables he runs the risk of having them stolen. During their break each student has three options; being sneaking (stealing), being trusting (leaving his valuables), and being careful (taking his valuables). We can illustrate this 'library game' in the following payoff matrix:

Student 2

Student 1

	C	S	T
C	1, 1	**1**, 1	1, **3**
S	1, **1**	**1**, **1**	**10**, -20
T	**3**, 1	-20, **10**	3, 3

From this matrix we can easily see that the only Nash equilibrium is a suboptimal solution. That is to say, that regardless of what student 1 is playing, it is always more beneficial for student 2 to play sneaky. Because this game is symmetrical, it is also more beneficial for student 1 to always play sneaky.

Group selection and Social Norms from Hunter-Gatherer Societies

In Basu (1983) the question of why we pay taxi drivers is analyzed. Basu reaches the conclusion that we don't calculate complex equations and balance the probability of getting away versus getting caught. Instead, paying taxi drivers is simply something that we do. This essentially means that before a customer gets off a taxi, the only option for him is to pay; he does not even consider running away.

In Maynard Smith and Price (1973), the researchers applied game theoretical analysis to the behaviour of animals. In their paper they model a scenario between a hawk and dove, giving a similar payoff matrix to the one we described in the prisoner's dilemma. The hawk and dove were merely used to demonstrate aggressive and compromising behaviour respectively. Thus in a face off between two animals over food or a mate, the one who retreats exercises the 'dove' strategy, while the one who attacks exercises the 'hawk' strategy. The key difference is that unlike humans, animals are unable to make decisions. Thus, decisions are programmed; the dove *must* act like a dove, and the hawk *must* act like a hawk.

If we apply this phenomenon of pre-programmed decision making, we can explain why humans have been able to survive. It has been argued that our genetic makeup strongly influences the decisions we make. In his recent book, *The God Gene: How Faith Is Hardwired into Our Genes*, molecular biologist Dean Hamer proposes that there is a gene responsible for human spirituality[2]. He argues that such a gene has survived natural selection because it creates hope in humans and thus makes us more 'fit' than those who lack the gene thus hope. It has also been argued that there exists a gene that gives an individual joy when he punishes another individual. This gene would prove advantageous; if punishment imposes substantial costs on the punisher, criminals are likely to go unpunished, and thus are given an incentive to wreck havoc; this problem disappears if punishment provides positive utility to the punisher.

Suppose there exists a gene that gives us a preference to be trusting. It is clear how such a gene might survive group selection; societies that cooperate are more 'fit' than societies that do not and thus those that have a tendency to cooperate will survive[3]. This is confirmed by anthropologists who have noted that most primitive societies have 'possesory rights,' that is the one who sets the trap has the right to the animal. Much of the recent studies in evolutionary psychology have indicated that although societies have undergone massive development, the human brain is still wired to solve the day-to-day problems of our hunter gatherer ancestors.[4]

The Trusting Meme

Humans have the capacity to learn and thus it seems unrealistic to make the sweeping assertion that our genes simply do not allow for theft to an option available to rational students. Richard Dawkins (1976) suggests that ideas can spread through a society through a process of

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[2] Publications on genetics and predisposed behavior also include Hamer DH, Hu S, Magnuson VL, Hu N. and Pattatucci AML (1993), A linkage between DNA markers on the X chromosome and male sexual orientation." and LeVay S and Hamer DH (1994), "Evidence for a biological influence in male homosexuality."

[3] If we strike the sneaky option from both students, the Nash equilibrium shifts to each student playing trusting (T,T) with payoff (3, 3)

[4] See Leda Cosmides and John Tooby. "Evolutionary Psychology: A Primer" http://www.psych.ucsb.edu/research/cep/primer/html 11/22/2004

cultural evolution similar to biological evolution. Dawkins coined the term “meme” to describe this phenomenon. Heylighnen (1992) suggests that the fitness of a certain meme depends on three factors: the learnability of the meme; the tendency of memes to spread; and the survivability of the meme. It is easy to satisfy the first two criterion; when I first walked into the study lounges I immediately noticed that valuables were left unattended, this indicated to me that it was a safe environment and I too left my valuables unattended when taking study breaks. Because we assume that it is more beneficial to students if they don’t have to bring their valuables every time they leave their desks, the third criteria is also satisfied; in an environment where trust is assumed, the ‘trusting’ meme is fitter than the ‘cautious’ meme to take valuables with you.

If individuals can learn to leave their valuables behind, they can certainly learn to steal from others too. However, comparing the fitness of a ‘trusting’ meme to a ‘sneaking’ meme, it becomes clear that a ‘trusting’ meme is more likely to prevail. First, we must realize that although we can learn to steal, the ‘sneaky’ meme works in contradiction to our genetic disposition to trust[5], and is thus harder to learn that say a trusting meme that would work in agreement to our genetic disposition to trust. Second, the tendency of the sneaky meme to spread is low. Recall that if two students decide to steal from each other, they are no better off than if they just played cautious. A sneaky student would ideally want a society where everyone plays trusting. Thus it would be against their interest spread the sneaky meme. Although in a trusting environment, a student may be better off playing sneaky, because the sneaky meme is both harder to learn and slower spreading than the trusting meme, we can expect the trusting meme to prevail.

Imperfect Selection and Density Dependent Selection

The reasoning in the previous section suggests that the sneaky meme will ultimately become overrun by the trusting. However, it would be naïve to blindly accept this suggestion and

[5] Recall that humans are essentially, through millions of years of natural selection in hunter-gather societies, genetically predisposed to trust and cooperate.

our observations confirm our hunch; even at Uris library there are a small number of cases of theft each week.

In order to reconcile our observation with the theory, we must first realize that meme selection and genetic selection is imperfect. The human lung is highly inefficient and is only able to absorb a small percentage of the oxygen inhaled from the air. We have not developed more efficient lungs because the marginal fitness a human with a highly efficient lung has over a human with a regular lung, is not large, has not been needed in human reproduction. In the same way natural selection is not perfect, neither is memetic selection or group selection.

If we apply the concept of density dependent selection and use a more sophisticated model of the library game we can see how a small number of sneaky students might be able to exist in equilibrium. Suppose that in the there are 20 students in the library and each student is pre-programmed to play either sneaky, or a combination of trusting and cautious. Student 1 is the average student and when he gets up from his table he chooses only between playing trusting or cautious. We can illustrate his payoffs in the matrix below:

Students 2-10

Student 1		C	S	T
	C	1	1	1
	T	3	-20	3

If student 1 is playing trusting, and either of the other 18 students play sneaky, he will receive -20 utils. Thus in choosing between playing cautious or trusting, he compares the expected utility from playing cautious:

$$EU_C = \frac{n_c(1) + n_s(1) + n_t(1)}{19}$$

and from playing sneaking:

$$EU_T = \frac{n_c(3) + n_s(-20) + n_t(3)}{19}$$

Whereby the number of the other students playing cautious, sneaky and trusting are represented by n_c, n_s, and n_t respectively[6]. As long as $EU_T > EU_C$, the average student will continue to play trusting. Setting the two equations together and solving for n_s in terms of n_c and n_t we have:

$$n_s < \frac{2n_c + 2\,n_t}{21}$$

Because we know that there are only 19 other students, we can add the following constraint:

$$n_c + n_s + n_t = 19$$

thus we find that in order for sneaky individuals to exist in equilibrium, in a population of 20 individuals, it must be that $n_s < 38/23$.[7] If more than one person is sneaky, all the students will play cautious. The sneaky meme would no longer have any advantage over the cautious meme. In fact, the cautious meme would be much more fit because it is both easier to learn and easier to spread. Although the ratio of 1 in 20 may still seem high, it need not be. If we increase the expected disutility from having valuables stolen, the number of thieves per student would be significantly lower[8].

[6] Note that because we assume the students to be preprogrammed, the probability of a student playing a certain strategy is essentially the number of students divided by 19. i.e. if 3 play C, 3 play S, and 3 play T, $p_c = p_s = p_t = 1/3$

[7] See appendix Calculation 1

[8] See appendix Calculation 2

CHAPTER IV

UNCOOPERATIVE SOCIETIES: CHINESE INTERNATIONAL SCHOOL

In the earlier section I used Uris library at Cornell University as an example to illustrate a society, where in spite of high economic incentives to steal, students have a tendency to trust each other and theft is kept at a low stable state. At Chinese International School, the secondary school I attended in Hong Kong, the opposite is true. Security is tighter and because the school community is substantially smaller, the chances of being recognized are also higher. Furthermore, students rarely bring laptop computers to school, and valuables are limited to cellular phones and wallets. Thus it seems that while the expected payoff from stealing is lower than in Uris library, the risk of being caught while stealing is also higher.

The High School Game

The high school is essentially the library game with payoffs modified to reflect both the lower resale value of the valuables and the consequent lower disutility from having lower valued goods stolen.

Student 2

Student 1

	C	S	T
C	1, 1	**1**, 1	1, **3**
S	1, **1**	**1**, **1**	**5**, -10
T	**3**, 1	-10, **5**	3, 3

Note that the Nash equilibrium is the same as in the library game at (S, S). Applying the density dependent selection analysis used in the previous chapter, we realize that although the economic incentives to steal are lower, because the expected disutility is also lower, students are more likely to be trusting. If there are 80 students, it is possible for 12 sneaky students to exist in equilibrium[9].

Organized Crimes and Meme Spreading

In the Uris library example we concluded that although the sneaky meme makes each sneaky student better off, because the sneaky meme is both hard to learn and hard to spread, the sneaky meme is not likely to survive. However, as noted in the introduction, up to 20 wallets, music players or cellular phones might go missing during a 45 minute window. School officials concluded that it was evidence of organized.

From a memetic perspective, gangs and criminal organizations are potentially very dangerous to the fitness of a society. Earlier I noted that for a thief, the ideal society would be every being trusting and the thief being the only sneaky player. If two players are sneaky the same time, there is a possibility that they will steal from each other and thus whatever they gain is cancelled out. However, in criminal organizations there is intra-cooperation and thus thieves from the same gangs would not steal from each other. If we assume economies of scale, it would be in the interest of a gang member to spread the sneaky meme, or to recruit new members. Note also that once in a gang, it becomes easy to learn the sneaky meme; you would observe your gang members stealing and the payoffs they receive from doing so. In short the presence of a gang or criminal organization allows the sneaky meme to be on a higher fitness level than the trusting or cautious gene because, in addition to providing a higher payoff, the sneaky meme is now also easier to learn and more likely to spread. It is ironic that cooperation in gangs is the key ingredient to fostering anti-cooperative, or sneaky, behaviour.

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[9] See appendix Calculation 3

Beliefs and Justification

An individual's beliefs play an important role in his decision[10] making and although beliefs are difficult to study in both economic and evolution models, we must at least briefly discuss them in our analysis. The basic economic theory of marginal diminishing utility teaches us that as our consumption of a good increase, the less utility we receive from it. If I eat one chocolate bar I might want another one. But have eating 10 chocolate bars, I am not likely to be sick. In fact, the utility I derived from the 9th chocolate bar was probably lower than that from the 7th, and definitely lower than that from the first one. Thus, there is a tendency for the marginal utility to decrease with each chocolate bar. We can apply the same principal to wealth; if I only have $2, I would not likely be willing to give away $1, however, if I have $100, I would not likely miss the $1 even if it was stolen. Now consider a high school where there majority of individuals come from affluent families, it is possible for the following belief to formulate:

If I steal his phone, his parents will most likely buy him a new one.

In other words, the thief believes that he is causing minimal disutility to the victim. This belief is similar to the Robin Hood motto of "steal from the rich and give to the poor." This belief can help explain why millions of otherwise law abiding citizens who would never think to steal from a record store readily download illegal music with a clear conscience; the marginal cost of him owning a track of music is zero. This belief can provide justification for sneaky players and serve as propaganda to making learning the sneaky meme easier. Thus beliefs can help the sneaky meme become fitter.

Uncontrollable Decisions and Erroneous p_s

Earlier I noted that because the student's valuables in Chinese International School are worth less than those of the students in Uris library, the disutility from losing that valuable is also lower. The lower disutility can in turn help explain why we might find a larger number of sneaky students can exist in equilibrium in my secondary school.

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[10] See Basu (1993) and Denzau and North (1994)

Another explanation for a larger stable value n_s is that many times a student will by being forgetful, unwittingly play trusting. Also, we might note that if a student underestimates the value of p_s, the probability he will be stolen from, he will be more inclined to play trusting. If this is true more sneakers would be able to exist in equilibrium.

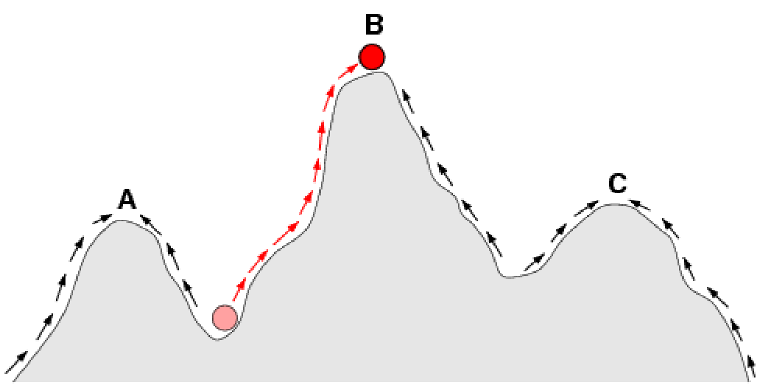
CHAPTER V

BIOLOGICAL EVOLUTIONARY OBSERVATIONS

In the previous two chapters we established that through memetic selection, group selection, density dependent selection and social norms it is possible for both highly cooperative and highly sneaky societies to exist in equilibrium. In this chapter we look at the biological evolutionary implications of these equilibriums and identify the difficulties inherent in shifting a society from a lower fitness peak to a higher one.

Adaptive Landscape

The concept of fitness landscapes was first introduced by Wright (1932) as model to visualize genotypes and replictory success. Below is an illustration of a fitness landscape[11]:



If we think of societies in this way, we realize that Uris library is an example of a society on peak B while my school is an example of a society on peak A or C. What also becomes clear is that peaks A, B and C are all Nash equilibriums. That is so say that by unilaterally deviating, no individual can be better off. Consider in my high school, if a student decides to play trusting, he will be taken advantage of by sneakers and thus on the adaptive landscape, we can imagine him

[11] "Fitness landscape." *Wikipedia, the Free Encyclopedia.* http://en.wikipedia.org/wiki/Fitness_landscape.

descending from peak A. Thus it seems that my high school is essentially 'stuck' at a lower fitness peak A.[12]

Hunter-Gather Societies and the Development Paradox

Recall earlier we that noted primitive hunter gather societies were highly cooperative and trusting. Societies that did not cooperate or have possesory rights would perish because the cost of playing cautious in a hunter gatherer society is much higher than that of playing cautious in the library. Compare the payoff matrix in the Hunter-Gather game to that from the library game:

Hunter 2

Hunter 1		C	S	T
	C	-1, -1	**-1**, -2	-1, **3**
	S	-2, **-1**	-2, -2	**10**, -20
	T	**3**, -1	-20, **10**	3, 3

In order for a hunter to steal from someone else's trap, he must leave his trap unattended. The two hunters steal from each other and thus are no better off than if they didn't steal and played cautious in the first place. However, realistically, you would have to travel a substantial distance to steal from someone else's trap and when both hunters are sneaking they receive a utility of -2 because they incur extra fatigue costs. Note that unsuccessful steals and playing cautious results in negative utility. This reflects the harsh environment in which hunter-gather societies existed. Playing cautious would mean sitting next to your trap and forgoing other activities such as building shelter and searching for water. Thus in order for hunter-gather societies to survive, hunters must both play trusting.

The irony lies in that technological advances developments in modern society, by lowering the cost of playing cautious the disutility from being stolen from, it has arguably pushed

[12] Another example of a socially inefficient equilibrium is the widespread use of the QWERTY keyboard. See David (1985)

society to climb to a lower fitness peak B instead of a higher fitness peak, A. If carrying your laptop or other valuables everywhere you went bore the same cost of going hungry and possibly dying from starvation, as was the case in hunter gatherer societies, my guess would be most societies would be at a fitness peak of A.

CHAPTER VI

CONCLUSION: IN SEARCH OF HIGHER PEAKS

Having analyzed both the societies in my high school in Hong Kong and Uris library at Cornell University, I was able to identify the factors that allow highly cooperative societies to become stable as well as those that allow highly uncooperative societies to become stable.

Even though societies have moved far past prehistoric times, the human brain is still hardwired to solving traditional hunter-gather problems. Because cooperation is the predominant social norm from hunter-gather societies, it is much easier for individuals to take on the trusting meme as compared to the sneaky meme. However, selection is not perfect and we are able to show that through density dependent selection a small number of sneakers are also able to survive in an stable trusting society.

In order for uncooperative societies to sustain a large number of sneakers in equilibrium the costs of being stolen from must be relatively low as in the high school game. Also, the presence of gangs and criminal organizations greatly increase the fitness of the sneaky meme by allowing the meme to be easily learned and quickly spread. In addition, we must also remember that carelessness or an erroneous estimation of the probability we will be stolen from, p_s, can also lead to a larger number of sneakers in a stable state.

From these observations, it is not clear why certain beliefs appear or how societies have managed to reach optimal cooperative peaks while others have only managed suboptimal uncooperative peaks. These are deep questions that are beyond the scope of this paper. However, what our observations do suggest is that in order for a cooperative society to perpetuate, emphasis must be put on using propaganda to aid the spreading of the trusting or cautious. In order to shift highly uncooperative societies to higher social fitness peaks, emphasis must put on combating gangs and organized crime. Also, increasing propaganda to aid the spreading of the cautious meme would also decrease the fitness of the sneaky meme; each sneaker is more likely to have unsuccessful sneaks. If a society is able lower its population of sneakers to a low stable state ,the society we can say that the society has ascended to a higher fitness peak.

As mentioned in the introduction, the purpose of this paper is not to create a workable program but rather to identify the causes. The specifics of any programs are beyond the scope of this paper and, as rightfully should be, are left to the brilliant minds who govern our society.

APPENDIX

Calculation 1

$n_c + n_s + n_t = 19$
$(n_c + n_t) = 19 - n_s$

$$EU_C = \frac{n_c(1) + n_s(1) + n_t(1)}{19}$$

$$EU_T = \frac{n_c(3) + n_s(-20) + n_t(3)}{19}$$

$$EU_C < EU_T$$

$$n_c(1) + n_s(1) + n_t(1) < n_c(3) + n_s(-20) + n_t(3)$$

$$21n_s < 2n_c + 2n_t$$

$$21n_s < 2(19 - n_s)$$

$$n_s < \frac{38 - 2n_s}{21}$$

$$23n_s < 38$$

$$\underline{\underline{n_s < 38/23}}$$

Calculation 2

$n_c + n_s + n_t = 19$
$(n_c + n_t) = 19 - n_s$

$$EU_C = \frac{n_c(1) + n_s(1) + n_t(1)}{19}$$

$$EU_T = \frac{n_c(3) + n_s(-50) + n_t(3)}{19}$$

$$EU_C < EU_T$$

$$n_c(1) + n_s(1) + n_t(1) < n_c(3) + n_s(-50) + n_t(3)$$

$$51n_s < 2n_c + 2n_t$$

$$51n_s < 2(19 - n_s)$$

$$n_s < \frac{38 - 2n_s}{51}$$

$$53n_s < 38$$

$$\underline{\underline{n_s < 38/53}}$$

Calculation 3

$n_c + n_s + n_t = 79$

$(n_c + n_t) = 79 - n_s$

$$EU_C = \frac{n_c(1) + n_s(1) + n_t(1)}{79}$$

$$EU_T = \frac{n_c(3) + n_s(-10) + n_t(3)}{79}$$

$$EU_C < EU_T$$

$$n_c(1) + n_s(1) + n_t(1) < n_c(3) + n_s(-10) + n_t(3)$$

$$11n_s < 2n_c + 2\,n_t$$

$$11n_s < 2(79 - n_s)$$

$$n_s < \frac{158 - 2n_s}{11}$$

$$13n_s < 158$$

$$\underline{\underline{n_s < 158/13}}$$

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