WHEN IN ROME ..... A Test of Boyd and Richerson's Conformist Transmission Model CSRP 458

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June 23, 1997

Abstract

Do humans have a predisposition to imitate the most common behaviour? A test of Boyd and Richerson's (1985, 1991) conformist transmission model was undertaken using 105 first year psychology undergraduates (separated into 8 groups) in a computer practical class. A normally rare behaviour was modelled by a number of naive models. As each subject entered the laboratory the proportion of others modelling the rare behaviour and the behaviour of the newcomer were recorded. Logistic regression indicated that proportion of individuals modelling the rare behaviour was a significant predictor of imitation. No subject imitated the behaviour when the initial group size was three. Thirty one per cent of subjects imitated the behaviour when the initial group size was five and no subject imitated the behaviour when the proportion producing the behaviour was less than seventy one per cent. Phenomena such as this are discussed in terms of their contribution to an explanation of human cooperative behaviour.

1 INTRODUCTION

Human co-operative behaviour on a large scale is an evolutionary puzzle (Boyd & Richerson, 1985, 1991). In their cultural evolutionary model Boyd and Richerson propose that we have certain biases which enable us to adopt behaviours dependent upon what the people around us are doing. The frequency-dependent bias or conformist transmission model, which suggests that a naive individual in an uncertain environment is predisposed to imitate the most common behaviour could provide a partial explanation for large scale co-operative behaviour in humans. In this paper I review the social psychology evidence that is relevant to Boyd and Richerson's theory of conformist transmission and describe an empirical test of their model.

Boyd and Richerson suggest that culture evolves in a similar manner to genetic evolution and therefore models drawn from population genetics can be used to develop theories about the spread of cultural behaviour. Culture in the sense that Boyd and Richerson use it is defined as 'the transmission from one generation to the next, via teaching and imitation, of knowledge, values, and other factors that influence behaviour' (Boyd and Richerson 1985). The teaching and imitation that Boyd and Richerson envisage is a type of social learning. Imitation is social learning that can easily be distinguished from individual learning in that it allows one to tap into sources of useful knowledge without incurring the cost of discovering and testing the knowledge oneself. Therefore in a situation where individual learning could be potentially costly, an individual can chose to imitate rather than risk making a mistake.

The capacity for imitative behaviour is an integral part of any cultural explanation of human behaviour. To a certain extent a folk saying such as 'When in Rome, do as the Romans do' has cross-cultural commonalities. It is a directive for how we should behave in certain circumstances. The question of whether we have evolved "Darwinian algorithms' to make this type of behaviour easier, by reducing the cognitive, decision-making load, is an interesting one. The term 'Darwinian algorithm' is drawn from the evolutionary psychology literature (Cosmides, 1989; Cosmides & Tooby, 1992; Barkow, 1989), where the suggested presence of content specific cognitive mechanisms assumes that certain algorithmic processes take place. It can be suggested that an understanding of the psychological mechanisms that allow imitation are of prime importance within evolutionary psychology.

Boyd and Richerson (1985) drew on the past research of social psychologists on conformity ((Sherif, 1935; Asch, 1951; Jacobs & Campbell, 1961) to develop their conformist transmisssion model. These studies used perceptual judgement as the dependent variable. Asch (1951) described conformity in his perceptual judgement experiments as appearing in full force with a majority of three. Gerard, Wilhelmy, and Connolley (1968) in another perceptual judgement task found that there was a tendency for conformity to increase linearly with group size, although they found that the first few models of the behaviour had the most impact. Formal social psychology models of the influence of majorities and minorities ((Latane & Wolf, 1981; Latane, 1981; Nowak, Szamrej, & Latane, 1990; Tanford & Penrod, 1984) incorporated the findings from Asch (1951) and Gerard et al. (1968) into the development of their models. It therefore follows that the majority of research that has gone into the development of formal models of social influence (including Boyd and Richerson's model) have used perceptual judgement as their dependent variable. Implicit within the adoption of the findings from these studies is the acknowledgement that subjects will imitate a behaviour even when group size is small. Latane (1981) states ' the first person added to a social setting is expected to have the most impact' (Latane 1981 p 345). Mann's (1977) study differs from the aforementioned ones as he directly observed behaviour. He found that queue-joining in Jerusalem (where queuing is not the norm) required that a stimulus queue of six accomplices be present before there were significant levels of queue-joining behaviour.

Deutsch and Gerard (1955) distinguished between (1) normative social influence, where an influence to conform to the positive expectations of another person or group can lead to solidarity and (2) informational social influence, which is an influence to accept information obtained from another person or group as evidence about reality. Mann (1977) used Deutsch and Gerard's (1955) theory of social influence to try to determine the motivation of the queue-joiners in Jerusalem. He suggested that 'recruitment into the queue could be based either on normative social pressure (if the commuter was motivated out of concern for the threat of censure from others present) or informational influence (if the appearance of a queue suggested to the person that an appropriate custom had emerged at Jerusalem bus stops)' (Mann 1977 p 441). Mann (1977) pointed out that informational influence would occur under conditions of ambiguity, where an individual is uncertain of how to behave. He concluded that this was not the case in his study, as the dress and manner of the commuters suggested that they were residents of the city and not tourists or strangers It was therefore probable that normative social influence was an important factor.

When uncertainty about how to behave in an ambiguous/uncertain situation is a potential factor, then informational social influence may play a greater part in influencing behaviour. Most social psychologists looking at social influence and conformity take into account both thoughts and feelings. They often assess the degree of conformity based on attitudes, opinions and answers to specific questions. Bandura (1986) suggests that observational learning (true imitation) requires a number of processes; attentional, retention, production and motivational. The type of imitation required in doing an act from seeing it done does not always require all the processses that Bandura (1986) postulates. When uncertainty about how to behave is a factor, the most important information extracted from the environment may be the frequency of individuals producing the behaviour.

It is therefore proposed that some imitative behaviour is spontaneous and is produced through a predisposition to imitate the most common behaviour. In an environment where one is unsure of oneself, to copy what the majority of other people are doing is an economical way of adopting the most adaptive behaviour. It does not always have to be the case that the behaviour is the most adaptive. Cultural evolution operates horizontally, relatively quickly but not always efficiently. It is possible that social learning in the form of conformist transmission may result in the spread of maladaptive behaviour in human populations (Feldman & Laland, 1996). The cognitive mechanism that allows one to judge what is the most common behaviour and copy it (sometimes without conscious thought) is an adaptation but it does not necessarily follow that the outcome is always adaptive.

In order to rule out any possible effects of social facilitation, where a well learned or automatic behaviour could be produced through the presence of others, it was decided that in the context of this experiment a rare behaviour would be modelled. The aims of this study were: to empirically test Boyd and Richerson's conformist transmission model and in particular to look at the contribution of group size and relative frequency on an individuals predisposition to imitate behaviour.

2 METHOD

2.1 Subjects

Subjects were 105 first year Sussex University psychology undergraduates (separated into 8 groups) who were attending their first computer practical class. The age range was 18 to 49 years and the average age was 23.9 years. Twenty subjects were male and eighty five subjects were female. The subjects were not informed that an experiment was taking place.

2.2 Apparatus

Twenty one network PCs with standard keyboards and rigid plastic keyboard covers, which were situated on three rows of desks with seven in each row. The computers were housed in a rectangular room with the entrance being opposite a window which was the full length of one of the longer walls. The row of computers nearest the window had screens that faced the window, the other two rows had screens that faced the door (see figure 1). There were typewritten instructions placed on the screens of some of the seven computers facing the window. The instructions were: 'IMPORTANT (printed in red ink) Please place keyboard covers on top of the computer'. Some computers had 'OUT OF ORDER' placed on the screen.

2.3 Procedure

The subjects were divided into eight groups (A-H) with between eleven to sixteen individuals in each group. (The numbers in each group could not be controlled for as this was a research methods class and was subject to timetabling requirements). There were two groups in the control condition (where no-one observed instructions to put their keyboard cover on top of their computer), two groups in three model condition (where three individuals obeyed the instructions to place their keyboard covers on top of their computers) and four groups in five model condition (in which

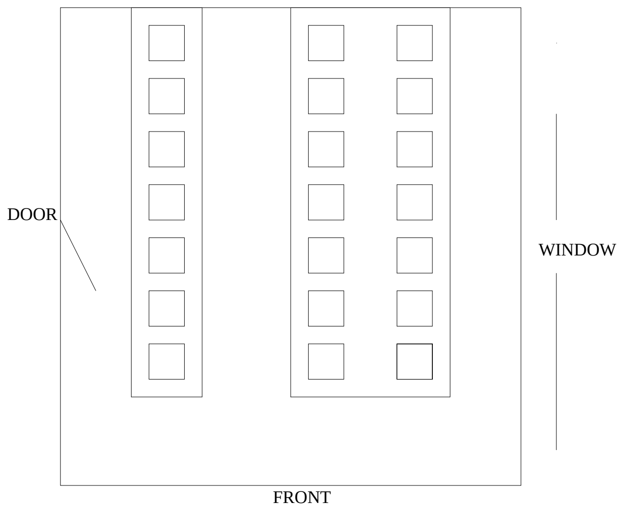

Figure 1: The laboratory showing positions of the computers

five individuals obeyed the instructions). The first part of the procedure was the same across all eight groups. Each subject was stopped at the door of the computer laboratory by the tutor, asked to sign their name in the register and then questioned about a photograph (for administration purposes). This delaying tactic was sufficient to enable the experimenter to observe each student enter the room separately.

Groups A and D were the control groups. The purpose of having a control group was in order to demonstrate that putting a keyboard cover on top of the computer was a rare behaviour. For group A; two computers at either end of the row of seven computers opposite the window had an 'OUT OF ORDER' sign on them. For group D; three computers at the furthest end of the row had the 'IMPORTANT' sign on them and the other four had out of order signs on them. (In this group no individual followed the 'IMPORTANT' instruction, so that this group effectively became another control group i.e no behaviour was modelled to be imitated).

Subjects were given two instructions as they entered the room: 1. They were directed to the specific computer they were to use. 2. They were asked to remove their keyboard cover but not switch the computer on. When the first subjects entered the room they were instructed to occupy seats opposite computers which were nearest the window. When the three seats oppposite these computers were occupied, the remaining subjects were instructed to occupy the seats opposite computers in the middle row (these screens faced the door). If there were more than seven remaining subjects, the eighth, ninth etc. were asked to occupy the seats nearest the door. No subjects in the middle row or the row nearest the door could see the instructions on the computer screens facing the window.

The number of subjects that followed the instructions placed on the computer screens was recorded. The number of subjects in the middle and furthest row, that placed their keyboard cover on top of their computer was recorded. The sex of all subjects was also recorded.

For groups B and C; three computers in the row opposite the window had the 'IMPORTANT' sign on them and four had the 'OUT OF ORDER' sign on them. The subjects who sat at these computers became the (unknowing) stooges. The remainder of the procedure was identical to condition one.

For groups E, F, G, and H, the first five computers in the row opposite the window (starting with the furthest one) had the 'IMPORTANT' sign on them. The remainder of the procedure was the same as condition one, apart from the fact that five subjects (the unknowing stooges) were directed to sit in the row opposite the window.

2.4 DESIGN

This study used naturalistic observation with experimental manipulation. The subjects were not informed that an experiment was taking place and it was subsequently discovered during debriefing that the students were unaware that they had taken part in an experiment.

The first experimental hypothesis was that subjects in a group will imitate a rare behaviour if there are a number of models of that behaviour. This is a necessary condition for conformist transmission to occur. An independent subjects design was used and the independent variable was the number of models of the behaviour, while the dependent variable was the number of subjects who imitated the behaviour.

The second experimental hypothesis was the conformist transmission hypothesis which states that the conformist rate would vary directly but non-linearly with the relative frequency of models of a behaviour. The precise function relating conformity to frequency of models was proposed by Boyd and Richerson as follows: when there is a cultural variant c, which has two variants c or d, and the frequency of c in the set of models is greater than one half, the probability that a naive individual acquires c with frequency-dependent transmission is greater than at the same frequency with unbiased transmission (where an individual randomly adopts a model). When the frequency of c among models is less than one half, the probability of acquiring c is less than one half, the probability is reduced relative to unbiased transmission (Boyd and Richerson 1985).

The equation for conformist transmission is:

$p' = p + Dp(1 - p)(2p - 1)$

Where p is the frequency of c in the population of models (the number of people who have their keyboards on top of their computers) and D is the frequency-dependent bias parameter. If D is greater than 0 then conformist transmission creates a force increasing the frequency of the more common variant in the population. That is, if $p > 0.5$, then $p' > p$, and if $p < 0.5$, then $p' < p$. This means that when there is a predisposition to imitate the most common behaviour i.e D is greater than 0 and the proportion that are producing the behaviour is greater than half the population, then that behaviour will be more likely to be adopted than if an individual had randomly chosen a model to imitate. It can be noted that if the frequency-dependent bias parameter $D = 0$ then cultural transmission is unbiased and transmission leaves the frequency of traits unchanged.

Stated more informally; a naive individual in an uncertain environment is more likely to look around to see what other people are doing and imitate the most common behaviour.

For the first hypothesis there was a single, simple independent variable: whether models were present at the beginning of each session. For the more precise test of the conformist transmission model the independent variable varied by subject rather than by group. For each individual subject the independent variables were: the frequency of the models of the target behaviour, total group size and proportion of group size (the number of models of the behaviour). The dependent variable was whether that individual conformed or not.

3 RESULTS

3.1 Imitation and Model Frequency

The first section focuses on whether or not subjects in a group will imitate a rare behaviour if there are a number of models of that behaviour. In the control condition there were no models of the behaviour. In group A (n =13) no subjects were instructed to place their keyboard covers on top of their computer and no subjects placed them there without instructions. In group D (n=13) three potential 'stooges' were instructed to place their keyboard covers on top of their computers. These people failed to comply with these instructions (they were talking and failed to notice the instructions). These three individuals were not included in the data analysis. The remaining thirteen subjects were included as a second control group and no subject within this group placed their keyboard cover on top of their computer. The placing of a keyboard cover on top of a computer can therefore be categorised as a rare behaviour.

In the three model condition, which consisted of two groups, there were three unknowing stooges in each group who followed the instructions and placed their keyboard covers on top of their computers. In group B (n=10) and group C (n=8) no subjects imitated the behaviour of the models.

In the five model condition, which consisted of four groups, there were five unknowing stooges in each group who followed the instructions and placed their keyboard covers on top of their computers. In group E (n=9) one subject imitated the behaviour of the models, in group F (n=10) and group G (n=8) three subjects imitated the behaviour in each group. In group H (n=8) four subjects imitated the behaviour. The number of subjects per group who imitated the behaviour of the models is shown in table 1.

Table 1: Number of models, subjects and subjects who imitated the behaviour per group

GROUPS	MODELS	SUBJECTS	IMITATORS
A	0	13	NA
B	3	10	0
C	3	8	0
D	0	13	NA
E	5	9	1
F	5	10	3
G	5	8	3
H	5	8	4

The percentage of subjects who placed their keyboard covers on top of their computers in each condition (these do not include the unknowing stooges) is shown in table 2. There was a significant difference in the target behaviour between the no models group and the five models group (chi square = 9.699, df = 1, N = 61, $p < 0.001$). There was also a significant difference in the target behaviour between the three models group and the five models group (chi square = 7.139, df = 1, N = 53, $p < 0.01$). Essentially this indicates that imitation of a rare behaviour occurred more often with five models of the behaviour than with three or no models of the behaviour.

Table 2: Percentage who produced conformist behaviour in each group

No models	Three models	Five models
(n = 26)	(n = 18)	(n = 35)
0	0	31

3.2 Conformist Transmission

This section focuses on the second hypothesis, which predicts that a naive individual in an uncertain environment is more likely to look around to see what other people are doing and imitate the most common behaviour. Table 3 identifies each subject (C) that imitated the behaviour and their seating position within the laboratory. Subject number one would have been seated opposite an empty seat (if an 'OUT OF ORDER' sign was on the screen) or a model of the behaviour. The seating positions of the models are indicated by (M) in the table and the dots indicate that a subject who was not a model was sitting in that position.

Table 3: Table showing seating positions of models and subjects in the laboratory C = Conformist, O = Out of order, M = Model, '.' = subject

Subject	A	B	C	D	E	F	G	H
1	O	O	M	.	M	M	M	M
2	O	O	M	.	M	M	M	M
3	.	M	M	.	M	M	M	M
4	.	M	O	O	M	M	M	M
5	.	M	O	O	M	M	M	M
6	O	O	O	O	O	O	O	O
7	O	O	O	O	O	O	O	O
8	.	.	.	.	C	.	C	C
9	.	.	.	.	.	.	.	.
10	.	.	.	.	.	C	.	C
11	.	.	.	.	.	C	C	.
12	.	.	.	.	.	C	C	C
13	.	.	.	.	.	.	.	C
14	.	.	.	.	.	.	.	.
15	.	.	.	.	.	.	.	.
16	.	.		.	.	.		
17	.	.		.		.		
18				.				
19				.				
20				.				

To test this second hypothesis, it was necessary to to calculate the frequency of the behaviour (how many people had their keyboard covers on top of their computers) when each consecutive subject entered the laboratory. For instance, when there were just five models of the behaviour, the frequency for the subject who next entered the laboratory was equal to 1. The probability of each subject imitating the behaviour was then calculated using the conformist transmission equation:

$p' = p + Dp(1-p)(2p-1)$

For the purpose of this analysis it was decided to use a strong frequency-dependent bias parameter, where D = 0.9 (a weaker bias makes the predicted line more linear). This could be justified as it was assumed that the subjects were naive individuals in an uncertain environment and therefore would be strongly predisposed to imitate the most common behaviour.

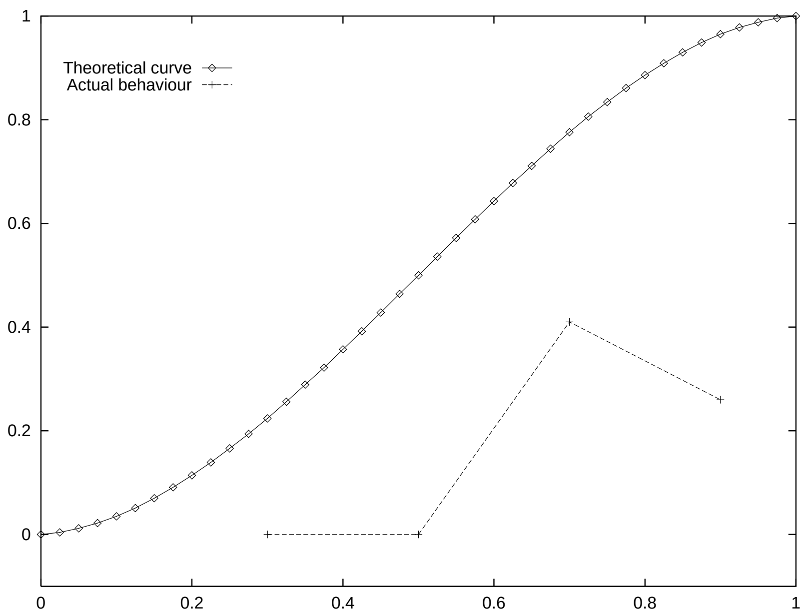

Figure 2: Observed versus predicted rates of conformity in a computer laboratory

The proportion of subjects who imitated the behaviour of the models and the proportion who would have been expected to imitate the behaviour of the models using the conformist transmission model were plotted (see figure 2). No subject imitated the behaviour when the percentage of models of the behaviour in the group was less than seventy one percent.

Logistic regression analysis was performed using the independent variables; group size, proportion of models and the interaction of these two variables. The dichotomous variable was whether or not the subject imitated the behaviour. Proportion was a significant predictor of imitation (df =1, $p < 0.02$).

The results of this experiment demonstrate that we have a predisposition to imitate the most common behaviour, but if it is a rare behaviour then there needs to be more than three people modelling it. Despite the finding that initial group size was important in certain situations, the logistic regression analysis demonstrated it is not group size but proportion which is the significant predictor of imitative behaviour.

4 Discussion

Boyd and Richerson's (1985) conformist transmission model predicts that if an individual joins a group, the probability of that newcomer adopting the most common of two behaviours is greater than if that individual had adopted the behaviour randomly. These predictions were not fulfilled in this experiment as it was not the case that each newcomer imitated the most common behaviour even when the frequency of the behaviour equalled 1, i.e. everyone in the room apart from the newcomer was producing the behaviour. When the initial group size was three, no-one imitated the behaviour. This calls into question the predictions made by Boyd and Richerson's model when group size is less than four.

Thirty one per cent of subjects who entered the computer laboratory imitated a rare behaviour when the initial unanimous group size was five and no subject imitated the behaviour when the proportion producing the behaviour was less than seventy one per cent. Logistic regression indicated that the proportion of individuals modelling the rare behaviour was a significant predictor of imitation.

Although there was a significant difference in the effect of three models of the behaviour compared to five models of the behaviour, group size proved to be a non-significant predictor of imitative behaviour. Past research on conformity is inconclusive on the effects of group size. Asch (1951) found that conformity did not increase above a majority of three. Gerard et al. (1968) found that there was a tendency for conformity to increase linearly with group size. Mann's (1977) study of queue-joining behaviour in Jerusalem, where he found that it required a stimulus queue of six accomplices before there were significant levels of queue-joining, is in accordance with the findings of this present study. We can therefore conclude that if it is a rare behaviour that is being modelled then it requires five or six models of that behaviour before the behaviour is imitated.

Further consideration of the differing degrees of conformity in the Asch (1956) and Gerard et al. (1968) studies and this present study leads to examination of the expectations of evaluation by the subjects. Although the subjects were naive in the Asch type perceptual judgement experiments, they were aware that they were taking part in an experiment. They were therefore conscious that their behaviour would be evaluated. This could lead to the type of strong conformity to a small group (less than three) that would not normally be produced in anything other than laboratory conditions. The subjects in this present study were unaware that an experiment was taking place. It is proposed that the imitative behaviour of the subjects was produced through their uncertainty about what was the correct way to behave in the computer laboratory rather than through any expectation that their behaviour would be evaluated.

The human capacity for imitation has often been dismissed 'Imitation as a cause of behaviour is now largely discredited' (Allport, 1924, p 390). Or overlooked: Flanagan (1989) is critical of the Lumsden and Wilson (1981) coevolutionary theory where they underestimate the value of of imitative behaviour 'They treat the disposition to imitate as a constraint on the epigenetic rule system rather than as an epigenetic rule itself. A strong case, could be made, I believe, that some such disposition is part of the initial rule system' (Flanagan 1989 p 268). Boyd and Richerson's cultural evolutionary model and specifically there notion of imitation of the most common behaviour suggests that individuals are predisposed to adopt the most popular cultural variant. This type of behaviour can lead to a decrease in cultural variation within groups relative to the between group variation. Ridley (1996) points out that the uniformity of groups that conform 'is a valuable weapon in a world where groups must act together to compete with other groups' (Ridley 1996 p 185).

The conformist transmission model is Boyd and Richerson's contribution to a theory of human co-operative behaviour. They argue that even though co-operative behaviour between group members rather than the pursuit of self- interest does not directly benefit the individual (and therefore should have become extinct in the process of evolution according to traditional evolutionary theory) the lower fitness of co-operators within groups could have been compensated for by a higher frequency of survival rate of groups with high frequency of co-operators. Conformist transmission can only lead to the spread of co-operative behaviour if that type of behaviour is restricted to a limited group. One such group would be the cultural group, where there is more co-operative behaviour towards in-group members and often unco-operative behaviour towards outgroup members.

In this present study subjects produced a rare behaviour upon observation of a number of models of that behaviour. Some subjects had difficulty balancing their keyboard covers on top of their computers but they still kept them there throughout the session. The subjects were debriefed two weeks later in their next computer practical class. It was observed during subsequent weeks that although the debriefing had taken place the rare behaviour persisted. Upon questioning the students who continued to put their keyboard covers on top of their computers it was discovered that they had been absent during the week of the debriefing. These individuals justified their continued behaviour in terms of 'well, it's obviously the best place to put it'. This was despite the fact that practically no subject had discovered this 'ideal' position for their keyboard covers in previous years. A suggested avenue for future tests of this model would be to see whether the transmission of the sub-optimal positon for keyboard covers could be maintained if there were potentially higher costs associated with it. The debriefing of the students could also be postponed until the next term to find out whether this behaviour would spread during their computer practical classes in subsequent weeks of the term.

This experiment was the initial stage of a series of experiments which will test Boyd and Richerson's conformist model. Further work may require some modification of Boyd and Richerson's model to take into account initial group size. It is questionable whether the particular behaviour in this experiment was adaptive or co-operative but the mechanism that caused the subjects to adopt the rare behaviour is an adaptation. The findings from this study do not fulfill the predictions of Boyd and Richerson's model in every case but they do demonstrate that we have a predisposition to imitate the most common behaviour (even if that behaviour is rare). Conformist transmission is a simple mathematical model that leads to the development of clear and testable evolutionary hypotheses about how and when people will imitate the behaviour of others. If we are unsure of ouselves we are more likely to look around at what other people are doing and imitate the most common behaviour. From this perspective the directive, 'When in Rome, do as the Romans do' can be seen as an adaptive shortcut.

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