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# Behaviour and norms: some experimental results for complex systems modeling

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*ABSTRACT. This paper is a review of some experimental results suggesting a way for modeling social interactions. We focus on two classical games, the ultimatum and the dictator game. Using observed facts in laboratory, we ask whether individual rationality could be explained by the presence of a norm of behavior. Norms suggest to individuals what is the appropriate behaviour in social interactions. They serve as a reference point for triggering sanctions by other players or emotional feelings for deviants. Actions are judged according to a norm and norms are themselves context dependent (actions available, framing effects, culture, decisional context). Norms emerge. Belief about the right « norm » depends on everyday observations. Behaviour is shaped by norms and norms by behaviour leading to complexity especially when interaction are localized.*

*RESUME. Nous passons en revue des résultats sur les jeux de l'ultimatum et du dictateur pour appréhender la modélisation des interactions sociales. On montre que le choix des actions des individus ne se fait pas seulement par rapport à la distribution des conséquences (présence ou non de préférences sociales) mais que cette distribution est souvent jugée par rapport à des critères normatifs dépendants du contexte (ce qu'il est normal de faire dans une situation pour une population donnée). La présence ou non d'alternatives de choix compatibles avec la norme affectera le jugement porté par les individus sur une distribution particulière de conséquences. De plus, les croyances quant aux comportements appropriés conditionnent les comportements eux-mêmes et entraînent l'apparition de normes qui peuvent évoluer en fonction du contexte par un phénomène d'apprentissage de la nouvelle norme.*

*KEY WORDS: norms , rationality, complexity, Ultimatum and Dictator game.*

*MOTS-CLÉS: normes , rationalité, complexité, jeux de l'Ultimatum et du Dictateur.*

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## 1 Introduction

There is a non trivial link between norms and individual behaviour. From the individual point of view, norms prescribe how individuals should behave in a given circumstance. They shape beliefs by suggesting the appropriate behaviour in a social context and by setting the frame in which actions are judged.. Olstrom [2000] states that “a norm,..., is the propensity to feel shame and to anticipate sanctions by others at the thought of behaving in a certain , forbidden way...”. From an individualism methodology point of view, one can say that norms are emerging from the actions of interacting individuals (Boudon [1998], Opp [2001]). Since behaviour is shaped by norms and norms by behaviour there is a non trivial retroaction leading to complexity. We will review some experimental results which will suggest how the usual utilitarian framework is affected by norms. We focus on two classical games, the ultimatum game (UG in the following) and dictator game (DG) which have received much attention in the past two decades. By surveying observed facts in the laboratory, we discuss the alternative hypotheses concerning individual preference modeling and the formation of expectations with respect to norms.

There is compelling evidence that individuals adhere to cooperative norms (empirically or factually observed) both in repeated and non repeated interactions. In public good games or prisoner dilemma, where individual and collective interests are in conflict, people cooperate although “rational” behaviour would suggest them to deviate (Ledyard [1995]). Since Adam Smith, economic theory has considered that self-interest in the driving factor of homo-economicus. The selfishness approach may explain cooperation by the repetition of the game (Axelrod and Hamilton [1981], Fudenberg and Maskin [1986] , Kreps *et al.* [1982]. In that case, cooperation is grounded on the concept of reciprocal altruism (Trivers [1971]): cooperation in bilateral interactions occurs only for the gain of future reciprocation. However self-regarding behaviour does not explain cooperation involving anonymous interactions in one shot games and experimental studies have shown that considering self-interest alone is not enough for explaining behaviour observed in the laboratory<sup>1</sup>. Two types of theories have been put forward to explain experimental data. Social preference models (Fehr et Schmitt [1999], Bolton et Ockenfels [2000]) posit that individuals are not only interested in their own gains but also by the distribution of gains among individuals. Reciprocal models (Rabin [1993], Dufwenberg and Kirchsteiger [1999], Falk and Fischbacher [2000], Charness and Rabin [2002] Bowles and Gintis [2003]) posit that the gains of others enter positively or negatively in the individual preference function depending on whether “others” are considered as being nice or mean to the player. Models based on reciprocity involve a concept of equilibrium based on psychological games (Geanakoplos *et al.* [1989]). Utility of a player is now a combination of the monetary outcome of the play plus a reward or punishment function depending on

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<sup>1</sup> The list would be to long but some examples are Camerer and Thaler [1995], Dawes and Thaler [1988], Camerer [2003], Fischbacher U. *et al.* [2001], Fehr and Gächter [2000], [2004], Fehr and Fischbacher [2004], Ledyard [1995].

intentions in the strategic play. Since intentions require beliefs of higher order (beliefs of the player on what others will play, belief about what others think the player will play, etc...), the cognitive capacity required concerning coherence of beliefs of different levels gives to norms a crucial role. They reduce the cognitive overload needed to “compute” the best action and enable individuals to correlate their actions on a common belief. In some sense, a norm becomes a shared belief on how to play. However, the concept requires that the adequate normative behaviour must be evident for at least some players, actions must be observed, and at least some people must be willing to punish deviants from the desired norm so that it becomes popular or self-sustained. Otherwise, actions may converge to an undesired norm (full defection in public good games for example).

In section 2, we present the experimental results of the Ultimatum game. In section 3, we consider whether the proposed split relates to a concern for fairness or merely to a strategic behavior. The dictator game allows us to discriminate (imperfectly) between both assumptions and show us that social distance and some reciprocal preferences driven by expectation exist. In section 4, we consider the responders’ rejection strategy and show that a lot can be explained by negative reciprocity although negative reciprocity is framed by norms. Notably causal attribution and contextual factors affect the rejection rate. In section 5, we conclude.

## 2 Experimental results and preference modeling

Individual rationality is explored in a game theoretical context by the use of an UG. Suppose that two individuals must share a pie of  $S = 100$  ECU in a one shot interaction. In all the following games, players play for real money (ECU are transformed into real money according to an exchange rate known to all individuals). Individual 1 (called the proposer in the following) offers a split  $(S-x, x)$  to the second player (called the responder) who may accept or refuse it. If the responder refuses they both end up with  $(0,0)$ . Any split of  $(S-x, x)$  can be supported as an equilibrium given a proposer’s belief about the responder’s rejection rate. However, the subgame perfect equilibrium would predict  $(99, 1)$  as a rational outcome. The argument goes as follow: the responder would accept any positive offer if he has a preference structure characterized by an increasing utility function for money. Under the assumption that the proposer knows that the responder is rational and selfish, a selfish proposer offers the lowest positive unit of money in play to the responder.<sup>2</sup> Many experimental results show the following (Camerer [2003]): the mode and median of the distribution are generally around 40-50 % of the initial pie and the mean offer around 30 %. Only a few offers are in low categories 0%, 1-10 % or the hyper fair category 51-100 % . Offers between 40-50 % are seldom rejected but offers under approximately 20 % or so of the initial stake

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<sup>2</sup>  $(100, 0)$  is another subgame perfect equilibrium where the responder accepts 0. However such an equilibrium prediction seems even less robust.

are rejected half of the time. These results are robust to the stake and notably the subgame perfect equilibrium is not the outcome (Cameron [1999], Slonim and Roth [1998]). How can we explain this divergence from theory? Since for one shot games, no incentive for intertemporal utility maximization exists, one assumption is that these offers reflect proposers' fairness consideration. Another assumption is that offers are strategic and maximize some utility of money given some beliefs about the responders' rejections rate. A DG (dictator game) discriminates between both assumptions since in this case the responder has no other choice but to accept the offer. In a DG selfish proposers should give zero. By contrast, any positive offer reflects a true concern for comparative payoffs and should be a measure expressing preferences for fairness. To present more formally the approach, consider the following simplification of UG where the proposer has only three actions. Either a split of  $a = (80,20)$  or  $b = (50,50)$  or  $c = (20,80)$ . Multi-criteria decision analysis postulates that an individual has a set of actions  $A = \{a, b, c\}$  and a set of dimension  $N = \{1, 2, \dots, n\}$  along which the agent evaluates each action. Moreover, for each dimension  $j \in \{1, \dots, n\}$ , the individual has a preference relation  $\bullet_j$  over his set of actions in  $A$  defining a preference profile  $p = (\bullet_1, \dots, \bullet_n)$ . The problem for the agent consists in finding a global preference function  $\bullet$  defined on the profile  $p$ . The dimensions reflect different objectives of the agent. If an agent maximizes only its own wealth then game theory traditionally assumes the existence of a Von Neumann and Morgenstern (VNM) utility function and the following normal form game is being played :

Proposer	Responder	
	A	R
a	$u_1(80), u_2(20)$	$u_1(0), u_2(0)$
b	$u_1(50), u_2(50)$	$u_1(0), u_2(0)$
c	$u_1(20), u_2(80)$	$u_1(0), u_2(0)$

**Definition:** *an egoist or self-interested individual is an agent that has a preference relation defined over its own outcome or function of its own outcomes .*

The agent may also have some distributional preference over outcomes. In that case some authors have assumed that agents have a preference profile defined by two criteria  $p = (\bullet_1, \bullet_2)$  the first criteria being his absolute gain and the second criteria a concern for social preferences including the other player's gain. For example, if player 1 is inequity averse then the absolute value of the difference between the profit of player 1 and 2 enters negatively in the utility function of player 1 (Fehr and Schmidt [1999]). More generally, the matrix becomes:

Proposer	Responder	
	A	R
a	$u_1(80,20), u_2(80,20)$	$u_1(0,0), u_2(0,0)$
b	$u_1(50,50), u_2(50,50)$	$u_1(0,0), u_2(0,0)$
c	$u_1(20,80), u_2(80,20)$	$u_1(0,0), u_2(0,0)$

Responders who reject positive amounts of money are irrational if they are only money maximizers. However, rejections may be explained by social preferences such as a preference for fairness. Strong reciprocity is another explanation that has been put forward in the literature (Gintis et al [2003], Gintis and Bowles [2001]):

**Definition:** *Strong reciprocity is the propensity of an individual to sacrifice resources to be kind toward those who are being kind or to sacrifice resources to punish those who are being unkind.*

Negative (strong) reciprocity is a motivation to adopt an action that harms someone else, at one's own material cost, because that person's intentional behaviour was perceived to be harmful to oneself. Perception, norms and context may thus determine what is considered as being kind or unkind. In that case, the general utilitarian model  $u_i(x,1-x)$  is not sufficient and the function  $u_i(x,1-x)$  should be context dependant. Notably the matrix of utility may change in different normative contexts. We show some experimental evidence on this. Ideally, we would like to shape the importance of the notion of norm in the definition of individual beliefs and preferences modeling.

### 3 Fairness or strategic offer?

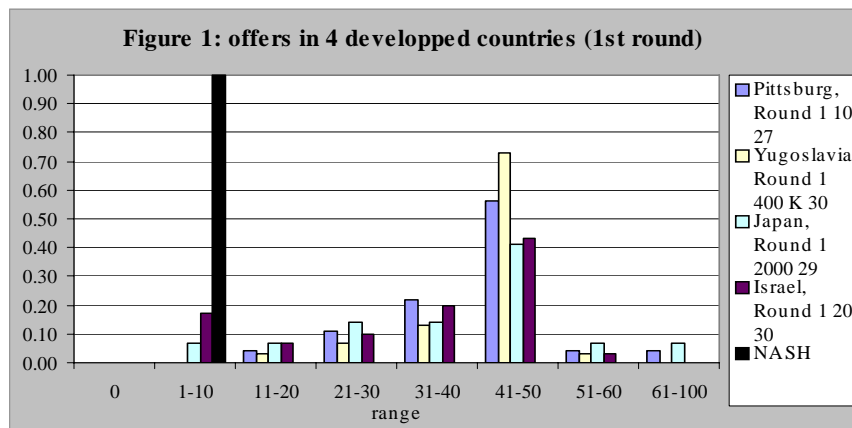
#### 3.1 Some results for the UG game

Are individuals egoistic maximizers or altruistic beings? Roth *et al.* [1991] compared UG played in 4 developed countries (US, Japan, Yugoslavia and Israel) over 10 rounds in a stranger design. Modal offers were all at 50% of the pie in all 4 countries in the first round of play. Given the rejection rate for all data over 10 periods, the modal offer in the last period (round 10) corresponds to the offer maximising expected outcome. There is some rationality in the proposer's offer<sup>3</sup>. Countries' discrepancy in offers increased over periods except for Yugoslavia and United states which had no significant differences in offers in the first and last

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<sup>3</sup> A stranger design insures that two players will meet only once in the repeated game. A stranger design should be equivalent to a one shot game since there is no incentive for an individual to build up a reputation. However, Abink *et al.* [2004] show that a group rationality exists. Some players reject more often when being able to build up a group reputation of being "tough" which in turn provides higher gains to responders in later periods. Indirect reciprocity (Alexander, [1987]) exists. Roth *et al.* [1991] did not control for this effect. This should reinforce the number of offers near 50%.

periods (mode at 50%) and remained the countries with highest offers (the mode of Israel was at 40% and Japan at 40 and 45%). A striking fact is that the distribution of offers in the first period are quite similar across countries (Israel and Japan being a bit more self-interested) revealing thereby some nearby distribution of beliefs (at the population level) about what should be an adequate offer. In addition, offers are far away from the subgame perfect equilibrium (figure 1) showing that proposers did not expect that responders were only selfish.



Moreover, rejections rates adapted over periods. Winter et Zamir [1997] showed a similar effect by considering an UG where real players played against a mix of virtual players (computer programs) and real players. They showed that real players adapt their beliefs and strategies to their environment: proposers learn to lower their offers in tough environments whereas responders learn to accept low offers in presence of tough proposers. As stated by Kahneman, Knetsch et Thaler [1986]: « Terms of exchange that are initially seen unfair may in time acquire the status of a reference transaction ». These first results seem to suggest that if some norm of fairness exists it is for strategic reasons (also Kagel *et al.* [1996]). Nevertheless, no country seems to be as egoistic as suggested by game theory. But high offers are merely a response to some belief about rejection rates and at best, only some individuals have fair preferences<sup>4</sup>. In other terms, most individuals are selfish but they know that an acceptable offer can only be around the fairness point. Henrich found probably was the most self-interested culture. The Machiguenga trib average offer was at 0.26 with a mode at 0.15 /0.25 (72%) and there was only 1 rejection (over 10). In a subsequent study, Henrich *et al.* [2003] showed that the ultimatum (UG) or public good (PG) games are played quite differently in 15 different tribes located in different part of the world. Mean offers vary between 26% to 58% (compared to 43-48% for games with students) and modal offers vary between 15% and 50% (students 50%). The tribes rank from society where the rejection in the UG

<sup>4</sup> Children are generally more self-interested than adult suggesting that what is considered as an acceptable offer evolves with age (Murnighan et Saxon [1998], Harbaugh *et al.* [2000]).

is very rare although offers from the proposer are very low. In other groups, rejection rates are substantial although offers are fair (status seeking competition). Except for two groups (Hadza and Sangu farmers), offers are generally different from a maximizing behaviour of proposers (even by integrating risk aversion) given responders' rejection rate. In order to explain data, other factors such as social preferences or "norms of playing the game" have to be considered. The authors show that a large part of the observed variability at the group level is explained by two factors: market integration and gains from cooperation. Market integration is highly correlated to the complexity structure of the group organization (family level of society through chiefdoms) which might constitute an explanation. The fair norm is more probable in groups with a high degree of market integration and large gains from cooperation. At the individual level, there are two possible interpretations of the result: either individuals maximize some generalized preference function over the distribution of outcomes. Or individuals have relative stable beliefs (perhaps more or less dispersed within the group) on the way they should act. These beliefs are inherited by every day life situations (for example hunter groups of large catches are more used to share the pie in a fair way). Thereby deviations from prescribed actions in these rule abiding groups, are more likely to trigger sanctions by others, reinforcing the respect for the rule. On the other hand, groups with relatively disconnected members are probably less constrained by norm abiding rules. In such groups, behaviour could be more dispersed (no true norm) or more self interested (an egoistic norm). For example, Machiguenga and Tsimane tribes live in societies with little cooperation, exchange or sharing beyond the family unit. There is little fear of social sanctions and little care about the public opinion. Machiguenga had the lowest offers with only one rejection and Tsimane had no rejection (mean offer at 0.37).

### **3.2 Comparing Ultimatum games and Dictator Games**

If responders are constrained to accept proposers' offers, strategic offers disappear. Forsythe *et al.* [1994] observed that contributions are lower in the DG than in the UG. In DG, 35% of offers were below 10% of the endowment whereas none was observed in the UG. Approximately 20% of individuals offered 41% or more compared to more than 60% in UG. Mean offers were at approximately 23% compared to 44% for UG. Thus a portion of offers in UG are strategic but not all individuals are purely self-interested, expressing apparently a concern for fairness. However, several results show that when social distance between players increases the mean contribution decreases (Bohnet and Frey [1999], Hoffman *et al.* [1994,1996], Haley K.J and Fessler [2005]. The fear of being observed and judged by peers seems to be an important concern for individuals and triggers expectations about normative behaviour. In turn, it suggests that pro-social behaviour in the DG may be an expression of reciprocity driven by expectations about what is an appropriate gift by the dictator. Pro-social behaviour are supported by emotions (Bowles and Gintis [2003]). Emotions are triggered whenever an individual feels



that he is acting meanly according to a certain intrinsic norm of behaviour. However behaviour must be observed. Thus in the case of the dictator such feelings is more or less activated by social distance or observable behaviour although the proposer has no reason to fear any monetary sanction. Some authors (Gneezy and Rustichini [2000], Barr [2001]) have suggested that social disapproval may work more effectively than monetary sanctions which are often seen by individuals as a price to be paid for not respecting the norm (Gneezy and Rustichini [2000]). Dana *et al.* [2006] showed that when an exit option is offered to proposers (they can leave the game without sharing the pie and get 9\$ out of a pie 10\$ leaving nothing to the receiver) then a significant proportion of agent prefer to take the exit option rather than sharing even if this implies a suboptimal allocation ((9,1) is better than (9,0)). These exit choices are clearly related to the fact that the dictator wants to avoid the judgement of the receiver (even for an anonymous game). When a new game is played where the dictator is insured that the origin of the gift will be hidden (i.e. the receiver will just be told that he gets an additional sum without knowing that it was left by the proposer) then the exit choice is no more used (except for 1 decision over 24). If actions are judged with respect to norms, beliefs about the appropriate norm will although depend on the context in which actions are taken. Chery *et al.* [2002] show that depending on the effort made by the proposers to win their income, the split will be different. In a double blind treatment with effort, contributions fall to zero in the DG. The context affects thus the social preference of individuals and they may become completely selfish under certain conditions. A way of modelling the agents' preferences is to introduce a third attribute into the preference function of a player which is an expression of emotions like guilt, shame, empathy (Bowles and Gintis [2003], Gordon *et al.* [2005], Phan and Waldeck [2008]). However such a component may be cultural, context and even individual specific. Moreover the activation of such a component will depend on the feeling (beliefs) about the appropriate norm.

#### 4 Rationality on the rejection?

Why do individuals reject a substantial amount of money in UG? Two possible explanations are inequity aversion (Fehr et Schmitt (1999), Bolton et Ockenfels [2000]) or negative reciprocity (Falk and Fischbacher [2000]). Falk et Fischbacher propose an UG that discriminates between the two hypotheses. They looked at the responders' rejection rates when the proposer plays strategy U depending on an outcome if the proposer would have played D (figure 2). Outcomes are represented by a couple of numbers where the first number represents the outcome to the proposer and the second to the responder. They proposed 4 treatments by varying the possible outcome for the path D (for proposer) followed by A (for responder). The four treatments were:  $(.,.) = \{(5,5), (2,8), (8,2), (10,0)\}$ . If the responder is only concerned by the distribution of consequences, the rejection rate if U is chosen, should not depend on what happens if he chooses D. Indeed, Falk and Fischbacher

showed that rejection rates (RR) when U depends on the outcome for the path (D,A) that is:  $RR(5,5) > RR(2,8) > RR(8,2) > RR(10,0)$ . Since  $RR(10,0) > 0$  some rejections may also be explained by fairness.

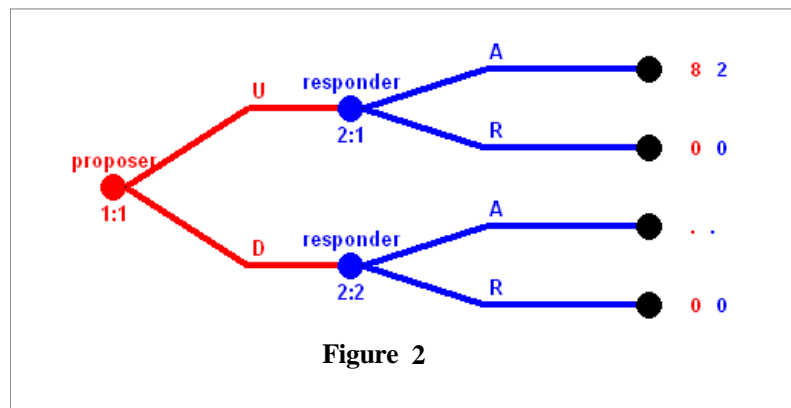


Figure 2

Responders may have two concerns when rejecting an offer. Either their beliefs about a norm of fairness are not met engendering disappointment. Or they may feel that the proposer's intention was mean. In the first case, rejection is independent on the origin of the offer. Blount (1995) shows that individuals have a need to infer causes and to assign responsibilities for why outcomes occur<sup>5</sup>. In a first study, she looked at the importance of causal attribution in the rejection of the responder. Three attribution processes were considered: Nature, a non interested Third Party Condition (3<sup>rd</sup> PC) and a self Interested proposer Condition (IC)<sup>6</sup>. Responders were asked to fix their Minimum Acceptable Offer (MAO) which was the lowest amount under which the offer was rejected. If Nature is the origin of the attribution then the observed MAOs are near the subgame perfect equilibrium. There was no significant difference in MAOs between the 3<sup>rd</sup> PC and the IC. One possible explanation is first in the responders' expectations: in the 3<sup>rd</sup> PC, responders expect a symmetric distribution of offers with a peak at 50% whereas the expected distribution is right skewed for the IC. MAO may thus be strategically lower in the IC. A second explanation is in the importance of relative payoff comparison for the responder: in the 3<sup>rd</sup> PC, responders are less concerned by comparative payoffs (because there is no intention involved in the split). This effect should induce lower MAOs in the 3<sup>rd</sup> PC than in the IC. Indeed, this latter involves intentions and a greater responder's willingness to compare payoffs and to reject low offers. Observations show that the two effects compensate. An additional explanation of high MAOs in the 3<sup>rd</sup> PC is the breaking of the expected fairness norm. Blount advanced then the hypothesis that if the stress is put on the impact of responders' rejection on the passive player 1 (not

<sup>5</sup> See also Kagel *et al.* [1996] for similar results on the impact of intentions and norm breaking on rejections.

<sup>6</sup> In the 3<sup>rd</sup> PC, the offer was made by a non-interested third party whereas rejection affected a passive player 1 (in the role of proposer of the UG) different from the 3<sup>rd</sup> party.

responsible for the split) in the 3<sup>rd</sup> PC, it should then reduce MAOs. In a 3<sup>rd</sup> study, she varied the procedure of the experiment. Instead of asking for a statement of MAO, responders were made clear by filling out a questionnaire (like the question below) of the impact of rejections of the offer in the 3<sup>rd</sup> PC on an innocent player 1. In this 3<sup>rd</sup> study, the 3<sup>rd</sup> PC showed significantly lower MAO than the IC (with same procedure). It shows that stressing on the impact of receiver's decision on an innocent player, may change the reference point of evaluation (whereas all other treatments i.e. MAO statements and interested party condition with questionnaire showed no difference). Blount and Bazerman [1996] found a similar effect of the elicitation procedure. They showed to subjects questions like : *suppose that the other player proposes to take 6 dollars and gives you 4 ; you accept the 4 dollars or reject and get zero?* The MAO reported in the condition asking for MAO was 4 (out of 10) while in the second condition it was 2.33 showing a framing effect of changing the reference point. By stating MAO, the reference point is the fair norm (for those "groups"), whereas answering the question, the reference point becomes zero.

## 5 Conclusion

The experiments presented suggest that individuals in a game are not only concerned by the distribution over outcomes (selfish or social utility) but that the concern of doing the right thing (i.e. meeting the expectation of others) is important. Actions are judged according to a norm and norms are themselves context dependent (actions available, framing effect, culture, decisional context). Norms emerge. Belief about the right « norm » of behaviour depends on everyday observations of individuals. An implication is that individuals may have different feelings about the right norm especially in local interaction structure where information is localized. Expectations are evolving according to observations. In the case where beliefs about the right norm are shared, each individual propensity to adopt the norm may depend on sanctions (real or moral) when not behaving as suggested by the norm and diminish the individual utility. Moral costs may be proportional to the number of adopters of the norm. The following example may highlight the process: everybody in a city may be convinced that the socially collective optimal behaviour is not to steal. If the norm is respected then an individual caught when stealing may feel ashamed. But if every body else is stealing in the city the shame may disappear. Gordon *et al.* [2005] and Phan and Waldeck [2008] showed that polymorphic equilibria with cooperation may exist, depending on the distribution of moral cost. Convergence to this equilibrium depends on the number of initial cooperators .

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