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Affective Social Ties—Missing Link in Governance Theory*

Abstract:

Although governance is about interpersonal relationships, it appears that the antecedents and consequences of affective bonds (social ties) in social groups dealing with common-pool resources and public goods have been neglected. The welfare costs of the neglect of such bonds and their dynamic properties in economics are unclear but may be substantial. In this paper, I discuss a theoretical 'dual process' social ties model and the behavioral experimental and recent neurological evidence this model has obtained. Furthermore, a number of implications and institutional issues are addressed.

1. Introduction

Economics is about the use and governance of scarce resources. An important subset of economic issues concerns the management of resources of which the use is accompanied by (positive or negative) externalities, as in public good or common pool environments. As a consequence, a key aspect of governance are interpersonal relationships. It is by zooming in on these relationships in the field and in the lab that 2009 Nobel Laureate Elinor Ostrom came to challenge the conventional wisdom that common pool resources will be poorly managed and should be either regulated by central authorities or privatized. By carefully studying how people actually behave she was able to show that standard (game) theory, albeit very useful as an analytical benchmark, fell seriously short of explaining that people often behaved much more cooperatively than predicted, using voluntary communication and sanctioning as important devices.

Towards the end of her paper on "Coevolving relationships between political science and economics" Ostrom argues that, in order to improve our understanding of economic and political behavior, we need to enrich the folk psychological model of *homo economicus*—a fully rational and selfish agent with unlimited computational capabilities and motivations. We should do so by including psychological theory in the exchange between economics and political science. In

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this context, she approves of the emergence of behavioral approaches allowing for heterogeneity and social preferences, where the payoffs obtained by others are included in an individual's utility: "The possibility that there are individuals who take into account the payoffs of other individuals changes theoretical foundations greatly. Now one needs to ask how individuals provide reliable signals to each other about preferences and intentions and how they gain information about the actions and outcomes of others." (Ostrom 2012, 14)

I share Elinor Ostrom's enthusiasm about these new developments.[1] I am a bit worried, though, that they may concentrate too much on strategic, reasoning related behavior. A rapidly growing literature suggests that emotions play an important role in economic decision making (for surveys, see: Elster 1998; Loewenstein 2000; Camerer et al. 2005). Therefore, in this paper, I would like to elaborate on a psychological mechanism that is more affect-laden. It relates to close relationships, a topic that is increasingly attracting attention in psychology as a key issue of an emerging relationship science (Reis et al. 2000). Close relationships are to be distinguished from the exchange relationships that economists typically focus on, in which goods or services are exchanged in repayment for prior benefits or in expectation of future benefits. In close relationships people care about each other, have a concern for each other's welfare, and respond to each other's needs. The goal of relationship science is "an understanding of relationship dynamics and the antecedents and consequences of these" (*op. cit.*, 844). As close relationships are typically considered to be more affect-laden (*op. cit.*, 845), the role of affect should be taken into account.

Evidence is accumulating that evolutionary old subcortical (emotional) processes in the brain are implicated in the establishment of social bonds among humans and non-humans, among kin (e.g. mother-child relationships) as well as non-kin (e.g. romantic relationships and, more generally, friendships).[2] The emotional systems involved have strong connectivity to the neocortex, implicated in reasoning and executive control processes. However, they may require little cognition and emotional arousal can be such that the associated action tendency may dominate behavior, as in the flight-fight response (see e.g. LeDoux 1996). Different forms of social interaction—like sexual intercourse and even touch—have been found to facilitate affiliation and attachment (e.g. IsHak et al. 2011), with the 'attachment hormone' Oxytocin possibly playing an important role in mediating the benefits of positive social interaction and emotions (Uvnäs-Moberg 1998; Uvnäs-Moberg et al. 2005). These older circuitries in the brain have not vanished with the progression of evolution but have been complemented and integrated with, from an evolutionary perspective, much more recent neocortical ones. As a consequence, and dependent on available mental resources and context, different types of preferences (motivations for action) appear to exist, characterized by different mixtures of emotional and cognitive brain activity. In a highly emotional context, with little room for cognition, the

[1] See e.g. Sobel 2005.

[2] See e.g. Panksepp and Panksepp 2000; van Winden et al. 2008.

action tendency related to the emotion can be determinant (like to flee or to fight in case of existential fear or to approach in case of infatuation). In contrast with the standard assumption of stable preferences, this literature suggest that preferences are endogenous—but systematic and apparently determined by stable brain mechanisms—in line with some recent thinking in economics (Bowles 1998; Brandts et al. 2009; Fehr and Hoff 2011).

Although governance is about interpersonal relationships, it appears that the antecedents and consequences of close relationships (affective bonds or social ties) in social groups dealing with common-pool resources and public goods have been neglected. To the best of my knowledge, only few (empirical) studies have argued in favor of the importance of affective (friendship) networks in collective action (Chong 1991; Reuben and van Winden 2008). Nevertheless, these networks are likely to be very important as closeness may solve important problems like trust, which is supposed to play a central role in coping with social dilemmas (Ostrom 2010). Also, by bringing social ties on board it is easily recognized—as Ostrom advises us to do—that individual behavior is strongly affected by the context in which interactions take place rather than being simply the result of individual differences. On and off over the last 15 years or so, I have been investigating together with others a dynamic 'dual process' model of social ties that acknowledges the significance of both emotional and cognitive factors in determining voluntary contributions to public goods. In the sequel, I would like to report on this research project—including some recent behavioral and neural findings—and discuss the implications for governance. *Section 2* presents the model and discusses some of its properties. *Section 3* goes into behavioral and some recent neurological experimental evidence that has been obtained regarding the model. Implications and institutional issues are discussed in *section 4*, while *section 5* concludes.

2. Incorporating Affective Bonds in the Standard Economic Model

The basic idea of the social ties model (van Dijk and van Winden 1992; 1997) can be expressed as a simple but fundamental rule for agents with very limited skills that are confronted with a highly complex and uncertain (potentially very dangerous) environment: 'bond if it does good to you', and 'flee or fight what is bad'. These responses are related to basic emotions, like anger and fear, with approach and avoidance as the respective action tendencies (Frijda 1986). Although humans distinguish themselves from other animals by having developed refined (prefrontal) cortical brain systems for reasoning and the control of impulsivity, these simple emotional ('limbic') mechanisms are assumed to be an important driving factor of behavior.[3] More specifically, the model hypothesizes

[3] Earlier studies emphasizing the importance of affective social ties include work by social psychologists, sociologists, and some economists (see Homans 1950; Simon 1952; Baumeister and Leary 1995; Granovetter 1973; Becker 1974; Coleman 1990). See also Lawler 2001.

that automatic affective responses to the interaction with another person (a social 'impulse') may change an individual's care about the welfare of that specific other person. For convenience, and in view of later applications, I will present here a linearized, discrete time version of the model while restricting attention to dyads, consisting of individuals i and j. Individual i's care at time t about the welfare of j is formalized by attaching a weight (α_{ijt}) to j's payoff (π_{jt}) in i's utility function (U_{it}):

(1) $U_{it} = \pi_{it} + \alpha_{ijt}\,\pi_{jt}$

where

(2) $\alpha_{ijt} = \delta_{1i}\alpha_{ijt-1} + \delta_{2i}I_{it-1}$

with α_{ij} denoting i's *tie* with j, δ_{1i} the *tie persistence* (inversely related to tie decay), and δ_{2i} the *tie proneness* of i (presumably related to personality traits like empathy), while I_i stands for the *impulse* mentally encoded by i. A tie is assumed to be fed each period by an impulse reflecting the (not necessarily conscious) affective experience triggered by the behavior of j. In case of a public good game the impulse is supposed to be related to the difference between j's most recent contribution C_{jt-1} and a *reference contribution* ${C_{it-1}}^{ref}$; for example, in the following simple way:

(3) $I_{it-1} = C_{jt-1} - {C_{it-1}}^{ref}$

Recently, we have extended this basic model by allowing for *stochasticity* (e.g. due to errors or experimentation) and *limited foresight* as suggested, for example, by the experimental findings of Keser and van Winden (2000).[4]

To illustrate the basic (myopic) model, represented by eqs. (1)–(3), consider the stylized Prisoner's Dilemma (PD) shown in figure 1. Neglecting time, for convenience, under standard *homo economicus* assumptions $\alpha_{ij} = 0$ and defection (contribution = 0) is the dominant choice, because it gives the higher payoff whatever the other does. However, if, for whatever reason (e.g. due to error, experimentation, or a personal trait), j decides to cooperate (contribution = 1), then i would experience a positive impulse if the reference contribution is 0. This would lead to a positive tie ($\alpha_{ij} > 0$), and would actually turn cooperation into a dominant action if $\alpha_{ij} > {}^1/_2$. This may also happen if the game is played only once but j decides first.

[4] See Pelloux et al. 2012. More specifically, intertemporal utility V_{it} is assumed to be determined by: (4) $V_{it} = U_{it} + \lambda_i U_{it+1}$, where λ stands for a discount factor. Assuming simultaneous choices in each period, optimization requires an expectation by i regarding j's current and next period's contributions, respectively, here denoted by ${C_{jt}}^{exp}$ and ${C_{jt+1}}^{exp}$. In light of the substantial evidence on conditional cooperation the expectation formation process is formalized in the following simple way (to economize on parameters): (5) ${C_{jt+1}}^{exp} = \varphi_i C_{it} + (1 - \varphi_i){C_{jt}}^{exp}$ ($0 = \varphi_i = 1$). Making the standard assumption of payoffs being linearly additive in contributions and allowing for (logit type) errors, this leads to a stochastic choice model where the probability p that i chooses contribution level k at time t is given by: (6) $p_{ikt} = \exp(\vartheta_i.U_{ikt}) \,/\, \sum_k \exp(\vartheta_i.U_{ikt})$, with p_{ikt} being a function of C_{it} only (given ${C_{jt}}^{exp}$).

		Individual *j*	
		Cooperation (1)	Defection (0)
Individual *i*	Cooperation (1)	$2 + \alpha_{ij}.2$	$0 + \alpha_{ij}.3$
	Defection (0)	$3 + \alpha_{ij}.0$	$1 + \alpha_{ij}.1$

Figure 1: Prisoner's Dilemma: cells show payoff to i (similar payoffs hold for j)

Note that, as perceived of here, a social tie is: (1) *dynamic*, as it evolves during interaction; (2) fed by *emotional* experiences (impulses); and (3) *individualized*, being related to a specific other person and not assuming trait-like other-regarding preferences.[5] The model allows for trait-like other-regarding preferences (such as altruism or spite) by leaving open what the initial weight (α_{ij0}) is. Furthermore, note that a social tie can also become negative ($\alpha_{ijt} < 0$), in which case the individual would be willing to incur costs to hurt the other individual.

More specifically, the extended social ties model (eqs. (1)–(6), see footnote 4) allows for the following types of behavior:

- Standard *selfish behavior* (if $\alpha_{ij0} = 0$ and $\delta_{2i} = 0$ in eq. (2)).

- Standard *rational behavior* with no errors (if $\vartheta_i \rightarrow \infty$ in eq. (6)).

- *Strategic foresight*. Because the extended model incorporates one-period ahead forward looking behavior (see eq. (4)), it allows for future-oriented strategic behavior and the occurrence of more defection towards the end of a finitely repeated public good game (known as 'end-effect').

- *Fixed other-regarding preferences*, like *altruism* ($\alpha_{ij0} > 0$ while $\delta_{1i} = 1$ and $\delta_{2i} = 0$ in eq. (2)) or *spite/envy* ($\alpha_{ij0} < 0$ while $\delta_{1i} = 1$ and $\delta_{2i} = 0$ in eq. (2)). Even behavior similar to '*inequality aversion*' can occur, namely if players use their own contribution as reference contribution (that is, $C_{it-1}{}^{ref} = C_{it-1}$ in eq. (3)). Then, in a symmetric public good game where contributions are costly, $C_{jt-1} > C_{it-1}$ not only implies advantageous inequality for i but, in the social ties model, also a positive impulse inciting i to contribute more (via eqs. (1) and (2)). On the other hand, $C_{jt-1} < C_{it-1}$ would imply disadvantageous inequality and a negative impulse for i inciting i to contribute less.

[5] Our model clearly differs from the signaling model of Levine (1998) where the weight one attaches to other's utility is influenced by one's belief about the weight other is attaching to one's own utility, and where the true weights are assumed to be fixed personality traits. In the related theoretical model of Sally (2001) people can even strategically select the weight they attach to other's utility (their sympathy level).

Moreover, it allows for various kinds of behavior that have been found important in explaining cooperation in PD environments, also from an evolutionary point of view:

- *Mimicking behavior*. Because an individual's contribution level is determined by the tie with someone else which in turn is related to impulses generated by the other individual's contributions, mimicking behavior can result. For example, in the above PD, individual i will mimick j's choice if $\delta_{1i} = 0$ and $\delta_{2i} > {}^1/_2$ (assuming the reference contribution is 0). For, in that case, $\alpha_{ijt} = 0$ if j defects, which induces i to defect as well, and $\alpha_{ijt} > {}^1/_2$ if j cooperates, inducing i to cooperate.

- *Direct reciprocity*. In fact, the behavior just discussed may perhaps be better described as a form of direct reciprocity, namely 'tit for tat', because of the affective nature of an impulse. Note, however, that the model can allow for more complex behaviors like 'tit for two tats' or still more general forms, depending on the precise nature of the tie mechanism.[6]

- *Indirect reciprocity*. Social ties can also naturally lead to indirect reciprocity where someone reciprocates someone else's behavior affecting a friend. This may come on top of (internalized) norm-related forms of reciprocity.

- *In-groups and out-groups*. Through social ties people get linked into affective social networks that function like reference groups (see Malmendier and Schmidt 2011) and naturally lead to 'us-them' distinctions.

- *Emotional and behavioral contagion*. Via affective social networks moods and emotions and related action tendencies are likely to spread because people care about their 'friends' (sense of 'oneness'); an opposite effect is likely to happen in case of negative ties, as people may experience gloating or Schadenfreude when their foes are experiencing negative emotions. Of course, as for social ties, a capacity to empathize would be important for such effects to happen (van Winden et al. 2008).

All in all, the social ties model turns out to be remarkably flexible, theoretically. Note, however, that this flexibility is empirically restricted by the fact that the model parameters can be estimated, as will be shown below. From a wider perspective, by incorporating affective bonds in the standard model, adaptive interpersonal relationships generated through interaction are to be expected, with ties (and, thereby, social preferences) changing over time dependent on personality traits, past experiences and contexts (see below). Key for the social ties model is that adaptations show an important affective component and are not (predominantly) based on changes in beliefs (although beliefs may change as a

[6] For instance, in the PD example 'tit for two tats' would result if $\alpha_{ijt-1} = \delta_{2i}$. $Impulse_{it-2}$ and $\delta_{1i}.\delta_{2i} > {}^1/_2$ which might happen if for some reason (emotional) memory is restricted to at most two periods back (so that $\alpha_{ijt-2} = 0$).

consequence).[7] The next section goes into behavioral and some recent neurological experimental evidence that has been obtained regarding the model.

3. Behavioral and Neurological Evidence

In the meantime, we have obtained various pieces of experimental evidence supporting this model. First, indirect support exists from a series of behavioral experiments. To measure social ties empirically we applied an adapted version of the so-called 'ring-test of social value orientation' (Liebrand 1984) twice, before and after interaction in a public good game. The ring-test of social value orientation measures people's preferences regarding own-other payoff allocations by having them repeatedly choose between such allocations, where the other is an unknown, randomly chosen participant in the experiment (a *generalized other*). We obtained an empirical assessment of the social tie between specific players by applying the test also after interaction in the public good game (in a one-shot environment with no further interaction or feedback), but then with a specific group member that they played the game with (a *specific other*). More specifically, we regressed the post-test measure on the pre-test measure and an indicator of interaction success (earnings or other's contributions). This way, van Dijk et al. (2002) established that social ties in a two-player public good game occur and can be explained by how well the interaction worked out, in line with the social ties model. This finding was corroborated and extended by Sonnemans et al. (2006), using four-player instead of two-player groups, to make sure that it was not simply a mood type of effect. As should be the case, they found that intra-person differences in social ties with other group members are related to the differences in their contributions to the public good. Using a repeated PD game, Brandts et al. (2009) further established that the impact of interaction success on social ties is indeed mediated by emotions (measured through self-reports), as assumed in the model.[8]

Recently, we have carried out a neuroeconomic study (using fMRI) of a two-player public good game, in a setup related to van Dijk et al. (2002), to investigate whether neurobiological evidence exists for the proposed social ties mechanism. In a first study we find that a brain area associated with mentalizing about other's intentions and attending to other's behavior—the *posterior Superior Temporal Sulcus* (pSTS)—appears to encode a social tie, measured by other's more recent contributions as well as the self-reported liking of the other subject (Fahrenfort et al. 2012).

[7] In fact, the social ties mechanism in (2) is formally equivalent to a linear approximation of a Bayesian belief updating procedure, with the previous tie as prior and the impulse as likelihood of other's behavior, if the tie-parameter α_{ijt} is seen as an experience-based belief that the other is a 'friend' (or 'foe', if negative).

[8] Furthermore, Reuben and van Winden (2008) found that befriended participants are better in coordinating on reciprocity (in a power-to-take game), due to different emotional responses to a friend's behavior compared to a stranger's behavior. For some additional behavioral experimental evidence related to social ties, see Goette et al. 2012 and Malmendier and Schmidt 2011.

In two forthcoming papers we extend this analysis in two important directions. In one paper (Pelloux et al. 2012), in addition to some deeper analyses, we prepare the ground for a model-based fMRI approach by estimating the parameters of the (extended) model on the behavioral data of the public good game. The main findings of a straightforward analysis at the group level are: (1) substantial tie-persistence ($\delta_1 = 0.509$) and tie-proneness ($\delta_2 = 0.079$), (2) little evidence of strategic forward-looking behavior ($\lambda = 0$), and (3) evidence of stochastic behavior ($\vartheta = 0.045$).[9] Applied at the individual level, the model appears to track the often complicated dynamics of the interaction reasonably well. Figure 2 shows an example.

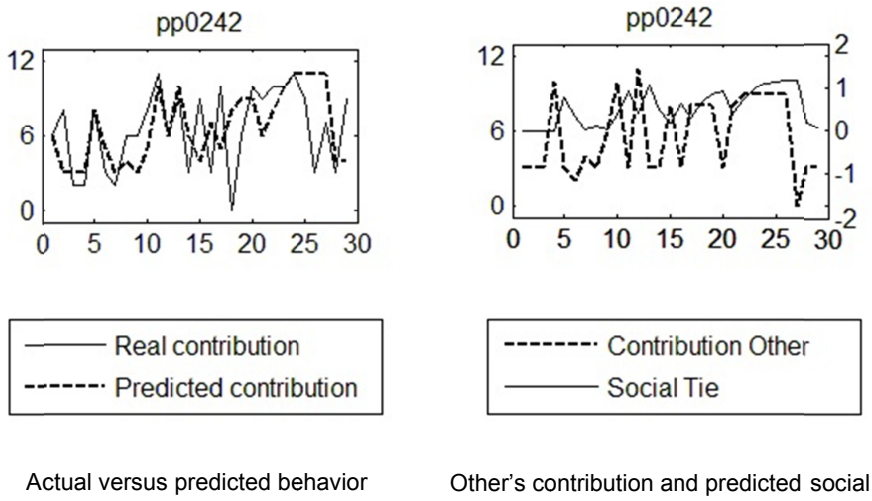

Figure 2: Illustrative results concerning participant 'pp0242'. Left panel: actual versus predicted behavior. Right panel: other's contributions and predicted social tie. Periods on horizontal axis (29 in total), contribution level (left) and tie-strength on vertical axes.

The other paper (Bault et al. 2012) relates the dynamic estimates of the social tie parameters α_{ijt}, based on the estimated model parameters at the individual level, to brain activity in a model-based fMRI approach. The main preliminary findings are: (1) pSTS activity tracks the development of the social tie, (2) pSTS activity modulates activity of the mPFC (medial prefrontal cortex, a brain area related to higher cognitive functions like goal planning, the processing of social information and long-term decision making), while (3) mPFC activity in its turn is related to the contribution level.

Thus, in addition to supportive experimental data, neurobiological evidence is obtained for the social ties model discussed in the previous section.

[9] The standard Nash prediction (that is, the dominant action for selfish people) appeared to be the best fitting reference contribution ($C_{it-1}{}^{ref}$).

4. Implications and Institutional Issues

The social ties model has important implications. First of all, it means that the free-riding problem may be less severe than the textbook treatments of public goods typically have it. Using homo economicus as model agent, standard Public Finance textbooks still start with public goods being a prominent example of a market failure offering a rationale for government intervention (e.g. Rosen and Gayer 2010). However, allowing for social ties even full efficiency is feasible through voluntary action, provided that sufficiently strong positive ties develop. Simulations with the model suggest that substantial efficiency improving effects may occur also with much larger groups than the ones studied in the lab, such as groups involving more than hundred people (van Dijk 1997). This would imply that no government intervention may be required in many interesting instances of public goods (or common pool resources). In fact, such intervention can lead to a decrease in the aggregate provision level (crowding-out), because it negatively affects the development of social ties. It is further to be expected that positive ties will breed trust, for why would one mistrust a friend? Note, however, that the predicted direction is from experienced feelings to beliefs, rather than the other way around (as suggested by the signaling model of Levine 1998).[10] Moreover, to the extent that positive ties that have developed between people in one environment extend to other environments—in line with the saying 'once a friend, always a friend'[11]—they are likely to generate helping behavior (like information sharing)[12] and indirect reciprocity. The latter further impacts the maintenance of norms, since individuals with ties care about each other's interests, which includes internalized norms. Furthermore, to the extent that one's social ties feed into one's more general attitude towards (generalized) others, they may even have cascade-like behavioral consequences for how one approaches strangers (Fowler and Christiakis 2010)

Opposite effects kick in, though, if social interaction turns sour and negative social ties start being developed. In that case, from a social welfare point of view, the outcome for a public good may be even worse than the standard Nash prediction, namely if this prediction entails a positive contribution (an interior Nash equilibrium). Because then people have an incentive to hurt the ones they have negative ties with even if it is costly to them (like in a bad neighborhood). Government intervention via public provision can be beneficial in that event, by weakening the negative ties. What may further complicate matters is that heterogeneity in terms of the valences of ties between people can occur; social ties need not be symmetric. Our theoretical and experimental findings suggest that this is related to heterogeneity in individual resources (endowments), pref-

[10] This further suggests that bridging close relationships (friendships) may be key in overcoming stereotypes among ethnically diverse groups, in line with 'Intergroup Contact Theory' in social psychology (see Pettigrew 1998).

[11] In fact, our behavioral experiments already show that people cooperating in one task are also more likely to do so in another task.

[12] Sometimes weak ties can be more beneficial in this respect; see Granovetter 1973.

erences regarding public goods, and personal traits. Furthermore, networks of social ties are affected by social mobility. Through out-migration networks may fall apart, for instance. Also via in-migration and enlargement of the relevant population the voluntary provision of a public good may be negatively affected (van Dijk and van Winden 1992; 1997).

These implications raise some interesting institutional issues to which I turn next. Elinor Ostrom's many studies demonstrate that people are not necessarily trapped in social dilemmas. To facilitate that individuals can solve social dilemmas themselves by becoming more cooperative and trustful that others will reciprocate, a number of attributes of micro-situations are deemed to be important: (i) communication, (ii) known reputations, (iii) high return on contributions, (iv) entry and exit capabilities, (v) longer time horizon, and (vi) agreed upon sanctioning capabilities (Ostrom 2010, 661–662). Overall, our theoretical and experimental findings regarding the (extended) social ties model are consistent with her view. Contact is key to this mechanism and communication will be instrumental in the development of affective bonds (i); a partners' setting, where people stay together and can build up a reputation, facilitates cooperation (ii and v); affective impulses generating ties are likely to become stronger the more important a contribution becomes (iii); external intervention can be detrimental by crowding out existing social ties (vi). It is only with respect to attribute (iv)—entry and exit capabilities—that the social ties model provides a clear caveat, due to the potential damage that migration may inflict on social ties networks (see also Ostrom 2000, on migration as threat). Moreover, as acknowledged by Ostrom, we cannot be overly optimistic and presume that dilemmas will always be solved by those involved this way. Actually, the very same micro-situational variables may be instrumental in the development of negative ties. As said, heterogeneity in individual resources, public good preferences, and personal traits appear to be important in this respect.

All in all, and in line with Ostrom's advice, the dynamic properties of social ties require a much more nuanced approach from an optimal governance point of view. In addition to the micro-situational variables discussed above, I would like to point at two further issues, which may belong to what Ostrom labels "the broader context of the social-ecological system". One concerns political participation. The model prediction that government intervention may have detrimental effects on the provision of public goods by crowding out social ties hinges on the assumption that no ties are generated in the context of public provision. However, it may be the case that social interaction through political participation (e.g. via forms of direct democracy) can substitute for private social interaction in the generation of social ties. As yet, we have no experimental evidence to offer on this issue. Furthermore, the importance of reference points in triggering affective responses (impulses) suggests that educational policies, like teaching tolerance, can be important for (future) governance.

5. Concluding Remarks

The welfare costs of the neglect of close relationships and their dynamic properties in economics are unclear but may be substantial, not only because of the rationale this neglect provided for government intervention in the provision of public goods but also because of the spill-over effects that social ties are likely to have (see below).[13] In any case, awareness of the dynamics of social ties may help to answer Elinor Ostrom's question "how self-organized resource regimes, that rarely rely on external third-party enforcement, frequently outperform government-owned resource regimes" (Ostrom 2000, 148).

Further research is needed, however, to delineate the precise nature, scope and restrictions of the social ties mechanism. Theoretical as well as empirical issues abound, such as:

- What is the impact of heterogeneity among individuals in terms of resources, preferences, and (cognitive and emotional) traits?

- How does the environment impact the development of ties? Are common pool resources (CPRs) different from public goods in this respect? For example, are they more likely to generate negative ties? And, how does this work for (types of) markets and other institutions? Furthermore, will a common (natural or social) threat facilitate the development of positive ties (see e.g. Hugh-Jones and Zultan 2010)?

- What happens if the number of people increases? What is the role of information about others' behavior and payoffs in the diffusion of social ties under these circumstances, relative to the experience of social interaction?[14] And, especially if numbers get large, to what extent are bonding (charismatic) leaders important to connect people? And, if different (e.g. ethnically diverse) social networks evolve, what is the role of bridging friendships in overcoming social tensions (see Pettigrew 1998)?

- To what extent are there spill-over effects? For example, to what degree does trust generated between people with positive ties in one environment extend to other environments? Furthermore, how significant is the recent evidence suggesting that individual behavior towards strangers is influenced by recent social experiences, like the (un)cooperative behavior of an

[13] On a timely note, close relationships are also deemed important for explaining the financial crisis and the diminishing faith in the financial system: "For many the crisis is the result of a shift from traditional 'relationship banking', where borrowers are well known to lenders, to a new system of arms-length finance, where investors buy bundles of anonymous loans packaged in a security. [...] But the new finance merely mirrors (and even lags behind) a more general trend in modern economies towards arms-length commercial ties." (The Economist, October 18th, 2008: The faith that moves Mammon)

[14] This issue is related to recent research suggesting that information gained via personal experience may be particularly influential in affecting beliefs and behavior (Haselhuhn et al. 2011; see also Rakow and Newell 2010).

interaction partner (Brandts et al. 2009), so that (un)cooperative 'cascades' may result (Fowler and Christiakis 2010)?[15]

- And how can we optimally use the social ties mechanism? For instance, how to steer people out of affective networks that are evaluated as negative, either because of the negative ties they consist of or because of the negative consequences they entail (think of bad reference groups with strong positive ties, like gangs)?

The social ties mechanism seems to be a flexible expression of a simple but fundamental rule for agents with very limited skills that are confronted with a highly uncertain and (potentially) dangerous environment: 'bond if it does good to you', and 'flee or fight what is bad'. These responses are related to basic emotions with approach and avoidance as the respective action tendencies (Frijda 1986). As discussed, the model allows for a range of behaviors stretching from very simple mimicking (tit-for-tat) towards more sophisticated behavior involving more extensive recall and some strategic foresight based on observed reciprocity. It allows for major mechanisms of cooperation that have been distinguished in evolutionary biology, like direct and indirect reciprocity (see Nowak 2006). In addition, the model has obtained empirical support from both behavioral and neuroeconomic experiments, showing that people can be more sophisticated and adaptive than 'simple' mechanisms like tit-for-tat suggest. Thus, also from an evolutionary point of view the social ties mechanism seems to have interesting properties that warrant further study.

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[15] An interesting hypothesis in this respect is that an individual's social value orientation (see van Lange 1999) reflects the accumulated effect of that individual's past experiences with interaction partners.

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