Forthcoming in Gert Tinggaard Svendsen & Gunnar L.H. Svendsen (Eds.), *Handbook of Social Capital*, Edward Elgar Publishing.

Social Capital in the Brain?

Michael Bang Petersen, Andreas Roepstorff & Søren Serritzlew

Introduction

The social capital concept has demonstrated its relevance. To name a few examples, it is crucial for understanding determinants of economic growth (Knack & Keefer, 1997), how democracy works (Putnam, 1993a), and more fundamentally, cooperation in collective action problems. But social capital is also a contested concept. There is no clear consensus on how to define it, some say that it is ambiguous, and some even that it should be abandoned (Arrow 2000: 4). One of the hotly debated topics relates to the psychological basis of cooperation. Is cooperation grounded in rational calculations, directed by strong social norms or soaked in affective and emotional motivations? Such core questions directly pertain to how social capital is translated into cooperative behavior by individual minds. The alternatives presented in the debate draw on significantly different models of the human actor, and as long as these questions remain unresolved, so will other core concepts such as cooperation and social capital.

This chapter reviews recent studies from the growing discipline of cognitive neuroscience. By offering the social sciences radically new kinds of data on psychological processes, these studies have the potential to shed new light on the psychological basis of cooperation and related questions. The message of this chapter is that the neuroscientific evidence strongly suggests that cooperative behavior is a real phenomenon motivated by the elicitation of context-sensitive emotional systems that primarily operate in situations of a moral character. However, it is also necessary to approach the new field of cognitive neuroscience with caution. We will return to this aspect in the conclusion.

The next section describes the contested nature of the social capital concept in more detail. We then move on to a description of the potential of cognitive neuroscience to shed light on some of the contested issues. This paves the way for a review of a series of studies where neuroscientific methods were used to investigate when and how cooperation emerges in experimental economic games. Based on this review, the idea of context-sensitive moral emotions is advanced. The chapter concludes with a discussion of, first, how the findings from neuroscience relate to the social capital literature; second, some limitations of the neuroscience perspective; and third, how to proceed further.

Social capital: Potentials and pitfalls

Why do people cooperate? That is one of the big puzzles in experimental economics and public choice. It is easy to predict how people should behave in, for example, the classic ultimatum game. In this game two players are to divide a dollar – or often more – between them. The first player proposes how to divide the amount. The second player either accepts the deal and receives his part or rejects it. In this case neither player receives anything. A rational and selfish actor should accept any positive amount, so the first player should propose a division that favors him and leave only a very small amount for the second player. It turns out that in reality this rarely happens. Starting with Güth et al (1982) many experiments have shown that subjects usually offer more balanced splits, and meager offers are routinely rejected even when stakes are very high. In Indonesia unbalanced proposals were turned down even in situations with stakes as high as three months expenditure of the average participant (Cameron, 1999). Hence, though it should be a trivial task for a rational and selfish actor to maximize his payoffs in the ultimatum game, it turns out that actual behavior is different, and that the seemingly rational strategy of splits favoring one self turns out in practice to be inferior to more equal splits. Similar differences between theory and reality are evident in other types of games. In the one-shot prisoner's dilemma game it is never individually rational to cooperate (although mutual cooperation maximizes joint payoffs). In experiments, however, subjects cooperate much more than would be expected theoretically (Ahn et al., 2001). This is also true when, from a theoretical point of view, cooperation is especially unlikely, for instance when the temptation to defect and the penalty for being a sucker (that is, to cooperate while the other subject defects) are high. In other bargaining games subjects tend to contribute to a public good, also when it is apparently not individually rational to do so, and even in the absence of sanctions (Yamagishi, 1988). Another interesting fact, which the social capital approach may help explain, is that the over-tendency to cooperate varies slightly in different cultures. In the ultimatum game, Japanese and Israeli subjects on average offer more uneven splits than American and Yugoslavian subjects (Roth et al, 1991). In the public good game experiments, American subjects contributed more to the public good than their Japanese counterparts (Yamagishi, 1988).

In other words, people tend to cooperate more than they should according to theories based on the assumption that people are selfish and rational, and they do so to different degrees. This kind of behavior is not puzzling in the social capital perspective; it is exactly what one would expect. Coleman (1988: S98) defines social capital by what it does. It is "a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors – whether persons or corporate actors – within the structure (…). Unlike other forms of capital, social capital inheres in the structure of relations between actors and among actors". Social capital can facilitate cooperation or in other ways explain deviations from rational behavior. As Putnam (1993b: 35-36) puts it, social capital refers to "features of social organization, such as networks, norms, and trust, that facilitate coordination and cooperation for mutual benefit". In groups with high levels of social capital cooperative behavior can be facilitated by high levels of trust, strong norms of reciprocity or behavior based on motives other than selfish ones (although certain fractions within the social capital approach tend to favor one of these explanations over the others, e.g. reciprocity over trust or vice versa). Since the amount of social capital varies – and it does, there are dramatic country differences in levels of trust (Inglehart et al., 2004: A165; Paldam & Svendsen, forthcoming) – the different levels of excess cooperation are also understandable. Due to social capital, cooperation is easier in some groups or areas than in others.

The social capital approach has shown its relevance by providing the concepts necessary for understanding and solving several old puzzles. But it is also fair to say that the approach is fuzzy. First, there is no consensus on how to define it (Sobel, 2002: 146ff). According to Coleman's functionalist definition (and Putnam's, see 1993a: 167), social capital is a property of the social structure; something that characterizes the settings or atmosphere in which individuals interact, and which affects how they interact. Portes (1998: 5) argues that this definition is vague. In order to avoid tautological statements, he holds that it would be helpful to exclude from the definition the sources and effects of social capital. Other researchers understand social capital as something possessed by individuals (see Portes 1998: 6), or as a preference to cooperate (Poulsen & Svendsen, 2005: 172). Social capital is higher in societies of people who are more likely to choose cooperative strategies. Second, central concepts in the social capital approach are elusive. Concepts such as trust and reciprocity are integral to many social capital arguments, but they are considerably more 'elastic' than the rigid concepts of rationality and selfishness in the public choice approach. Although the social capital literature has been very successful in its empirical investigations of cooperation, these considerations leave one wondering whether the social capital literature has been equally successful in explaining cooperation.

Consensus on how to understand trust and reciprocity, and ultimately social capital, is not likely to arise from elaborate discussions of the strengths and weaknesses of various definitions. One probable but not very satisfying source of consolidation is the empirical market place. In Friedman's 'as if' logic (1953: 18), the critical test of a theory is whether it works, not whether assumptions and definitions are correct. His famous leaf example is illustrative: "Consider the density of leaves around a tree. I suggest the hypothesis that the leaves are positioned as if each leaf deliberately sought to maximize the amount of sunlight it receives, given the position of its neighbors, as if it knew the physical laws determining the amount of sunlight that would be received in various positions (…) Despite the apparent falsity of the 'assumptions' of the hypothesis, it has great plausibility because of the conformity of its implications with observation." (Friedman, 1953: 19-20). Empirical studies show which concepts are more fruitful, and the quotations on the empirical stock exchange of the most useful understandings of the concepts will increase.

The pitfall here is that definitions and assumptions selected in that way risk being tautological. Many actions can be explained as results of rational and selfish behavior as long as convenient – and fruitful – assumptions on preferences can be made. As Wildavsky (1993: 155) phrases it: "Explanations based on self-interest give the appearance of mattering more than they actually do, as well, because they are often interpreted retrospectively to cover whatever happens. Why did a person sacrifice life or limb in a particular instance? Because that act was in the person's self-interest or the person wouldn't have done it." Various combinations and understandings of trust and reciprocity, and hence social capital, will in just the same way be able to explain just about any level of cooperation in a particular setting.

Another potential way to sharpen and define the central concepts is to look to other disciplines. In the following sections we follow this strategy. We do not claim that the concepts of trust and reciprocity – independently or together – define social capital, only that they are essential in most practical applications of the social capital approach. However, it is still contested whether trust and reciprocity are just the artificial expression of what is essentially strategic behavior of rational agents. By shedding some light on these concepts from the perspective of cognitive neuroscience, we hope to bring more nuances to the understanding of them. Particularly, we will argue that both appear to tap into processes and brain regions typically associated with emotions.

The potential of cognitive neuroscience

The empirical basis of social science theories is most often behavioral data. One problem with such data is that they only indirectly shed light on what most theories really are concerned with: the reasons for behaving in a certain way. The social capital literature is an example in point, as cooperative behavior is a well-established empirical fact. The real controversy regards why cooperative behavior happens: Is it self-interest, trust, social capital, etc.? Traditionally, we infer these whys by analyzing the contingencies of behavior, that is, the conditions under which it is present or not.

Cognitive neuroscience offers a qualitatively distinct kind of data. Breakthroughs in technologies such as the development of functional PET (Positron Emission Tomography) and fMRI (Functional Magnetic Resonance Imaging) allow the study of physiological correlates of brain activity when individuals act, solve problems, make decisions, form expectations and so forth. Briefly, these methods give a physiological measure of the activity in particular brain regions as a function of some task a person is performing while being scanned. Both techniques are based on the finding that the brain directs blood flow to active regions, probably to ensure sufficient oxygen and glucose for the task at hand. Most PET experiments use a tiny amount of radioactive water to track local changes in blood saturation, while fMRI measures the magnetic properties of the blood, which is a function of the availability of oxygenated hemoglobin, and therefore affected by the relation between changes in activity and blood flow. It should be noted that both techniques provide indirect measures of brain activity with a relatively coarse (a matter of seconds, at best) time resolution, and that the precise relation between the measures and the underlying brain activity is (still) a matter of debate (Frackowiak et al 2004).

As the knowledge about the functions of different brain regions expand, we may be able to get an idea about what processes underlie diverse cognitive tasks. In the end, this means that we through the neuroscientific approach get a more direct glimpse of the whys of behavior. Not surprisingly, the use of neuroscience in the social sciences is growing rapidly. Religious cognition (Persinger & Healey, 2002; Saver & Rabin, 1997), group relations (Harris & Fiske, 2006), the formation of political attitudes (Lieberman, Schreiber & Ochsner, 2003; Morris et al, 2003) and many other social science topics have been subject to neuroscientific inquiry. In this chapter, however, we will focus solely on one of the intersections between neuroscience and the social sciences, neuroeconomics (Camerer, Loewenstein & Prelec, 2005; Glimcher, 2003). The social capital literature has for a long time recognized the importance of studies in experimental economics focusing on cooperation in the prisoner's dilemma game, the ultimatum game, etc. As neuroeconomics is largely preoccupied with applying neuroscientific techniques to such experiments, this field holds an immediate promise of delivering important insights about social capital.

The social capital approach to understanding cooperation and interaction is flexible and it is not simplistic, but neither is it simple. Despite differences in methodology, objects of study, and scientific tradition, the social capital approach could perhaps become more simple – but not simplistic – by learning from neuroeconomics. Below we discuss a number of recent studies. They are briefly summarized in table 1.

Table 1. Overview of central studies in neuroeconomics relevant to social capital.

Study	Central results
McCabe et al (2001)	Increased activation in brain regions involved in reading intentions during cooperation with human partners
Rilling et al (2002)	Increased activation in brain's reward centers under mutual cooperation
Sanfey et al (2003)	Increased activation in brain regions linked to anger and disgust when turning down unfair offers
Zak et al (2004)	Oxytocin is released as a response to intentional signals of trust
de Quervain et al (2004)	Increased activation in brain's reward centers when engaging in altruistic punishment
Kosfeld et al (2005)	Oxytocin increases trusting behavior
Singer et al (2006)	Less activation in brain regions involved in empathy and increased activation in brain's reward centers when unfair opponents are punished

Neuroscience of trust and reciprocity

One of the first neuroeconomic studies to investigate the neural correlates of trust and reciprocity was conducted by McCabe and colleagues (2001). Although the reporting of the data and the level of statistical significance obtained do not quite meet contemporary standards, the issues touched upon are instructive for the approach as such. While being fMRI scanned, the subjects were exposed to a simple two-player reciprocal trust game in which they either played against a human or a computer for cash rewards. Based on behavioral analysis, the subjects were pooled into two groups, one where subjects showed cooperative behavior against the human opponent, but not against the computer, and one where they showed no significant cooperative behavior, regardless of opponent. An analysis of the brain scans revealed a pattern of (weak) activations mainly in the prefrontal cortex in the first group when the subjects cooperated with persons, while subjects in the second group showed no significant differences in brain scans between the two conditions. Notably, one of the strongest activations while cooperating appeared in the medial prefrontal cortex near an area also implicated in 'theory-of-mind' like tasks, that is, tasks where an individual takes into account the other person's knowledge or perspective (Gallagher, Jack, Roepstorff, Frith 2002; Gallagher & Frith 2003). For the current discussion, we can draw three relevant aspects from the McCabe study: 1) the degree to which subjects engage in cooperative relations in reciprocal exchanges is not evenly distributed within a randomly selected population (only about 50 % sought to collaborate with the human opponent); 2) the choice of a cooperative strategy seems to be contingent upon a contextual analysis of the exchange situation and of the nature of the opponent (no subjects attempted a systematic collaboration with the computer); 3) opting for a collaborative strategy makes for particular neuronal signatures (in this particular case a pattern of mainly prefrontal activity including putative 'intentional stance' regions).

Since then, a broad range of studies have examined in more detail various phases in cooperative and non-cooperative exchanges. In a paradigmatic study Sanfey and colleagues (2003) examined interactions in a variation of the ultimatum game. Briefly, subjects received offers from humans and computer opponents presenting them with a share of a known sum varying from 50/50 (fair) split to a 10/90 split (unfair). If the offer was accepted both parties would get their share; if the offer was rejected, however, everything would be lost. All fair offers were accepted, but contrary to rational choice theory, a significant proportion of unfair offers were rejected with a large intersubject variability (from 0 – 100 percent rejection rate). An analysis of the brain scans revealed a significant difference in the BOLD (blood oxygen level-dependent) signal in the right dorsolateral prefrontal cortex (a typical 'cognitive' area) and anterior insula (a typical 'emotional' area associated with feelings of anger and disgust) when subjects were presented with an unfair offer from a human opponent. Regression analysis revealed a between-subject linear correlation between acceptance rate and activity in right anterior insula, and also a highly significant difference between right anterior insula activity in unfair situations where offers were rejected, compared to unfair situations where they were accepted. This suggests, the authors conclude, that the areas of the anterior insula and dorsolateral prefrontal cortex represent the twin demands of the ultimatum game task, the emotional goal of resisting unfairness and the cognitive goal of accumulating money. Further, as activity in the 'emotional' region was a strong predictor of rejection, "models of decision making can not ignore emotions as a vital and dynamic component of our decisions and choices in the real world."

Although the interpretation may be somewhat heavy-handed, Sanfey's study was paradigmatic because it demonstrated that a balance between 'emotional' and 'cognitive' constrains on decision making in an interactive game was translated into brain activities. Economic interactions have therefore become research tools, also for studying other aspects of cognition and emotion. In one study, Tanya Singer and colleagues (2006) first exposed subjects to variations of prisoner's dilemma interactions with opponents who were either instructed to be fair or blatantly unfair. Interview ratings classified unfair opponents as significantly more unattractive and unpleasant and significantly less likeable. Subsequently, the subjects were scanned while they and their fair and unfair opponents were subjected to painful electrical stimulations. Analysis revealed that, particularly in men, there was significantly less activity in 'empathy' regions of the brain (in this study anterior insula and anterior cingulate cortex), when unfair subjects received electric shocks compared to when fair subjects got shocks. Further, again in men only, there was significant activity in a so-called 'reward' area of the brain (nucleus accumbens) when unfair opponents received electric shocks, and it was correlated with the desire for revenge. In other words, an unfair offer is not only often rejected on what appears to be emotional grounds (the *Sanfey et al* story). Acting unfairly seems to make individuals less attractive and likeable, and if pain is inflicted on such individuals their opponents are less likely to react with empathy: in fact, these individuals may trigger the sweet pleasure of revenge in those they treated so badly.

One of the key figures in the neuroeconomic investigations of human interactions is the Swiss economist Ernst Fehr. From a background in labor market economics (Fehr 2004), he moved to an investigation of 'fairness', first in behavioral experimental economics. Through a number of high-profiled pharmacological, fMRI and TMS experiments (e.g. de Quervain et al 2004, Knoch et al 2006, Kosfeld et al 2006), his research group has now taken these questions to the brain. Their study of 'altruistic punishment' (de Quervain et al. 2004) is exemplary in this regard. They used a simple economic trusting game where subjects where given the option to punish – at a cost – defectors who failed to reciprocate donations. Contextual modifications allowed for different scenarios where the opponents were constructed as responsible for the defection or as bound entirely by the rules of the game. Only in conditions where opponents were perceived as having a choice did defection give rise to a desire for punishment. The crucial examination was a PET scanning of the decision to punish and the results were quite stunning. When subjects meted out a costly punishment, there was activity in the caudate nucleus, a typical reward area. Furthermore, the activity in this region was correlated with the desire for revenge and the costs of getting it. In line with the study by Singer et al. (2006), the material costs of punishment seem to be outweighed by the pleasure of seeing justice served.

This is a highly interesting expansion on the neuroeconomic literature because the focus is shifted from the decision making process to the evaluation of the opponent. It is when the opponent is perceived as having some element of choice that the interaction acquires moral potential. The decision to punish seems to involve and be correlated with activity in deep-brain structures, in this case reward regions. There are also significant correlations with activity in cortical regions, but interestingly and potentially of ideological stripe, this aspect is hardly discussed. In any case, the paper is *gefundenes Fressen* for a social capital approach because it indicates that even in an interaction with a stranger one may never meet again, most subjects will incur significant costs to punish violations of a norm to reciprocate, and that there seems to be neuronal correlates of this desire.

In a later high-profiled paper, the group shifted focus to examine whether neuronal manipulation affected how trusting people would be with strangers in a simple economic game (Kosfeld et al 2005). Briefly, subjects were exposed to oxytocin, a neuropeptide known to play a role in social attachment and affiliation in non-human mammals. They then subjected them to a ‘trust game’ where they could give money to an opponent in the hope that he would return their investment. The neuropharmocological intervention significantly increased the invested sum, suggesting that ‘trust’ and cooperative behavior may be affected by neuronal mechanisms beyond conscious rational decisions. As picked up by Damasio in a commentary (2005), one should in the future perhaps beware of political operators who generously spray the crowd with oxytocin at rallies for their candidates. While Kosfeld et al. (2005) deal with the behavioral consequences of exogenously induced oxytocin, a study by Zak et al. (2004) investigates when oxytocin is released by the brain endogenously. In this study, the researchers also examined behavior using a trust game. More precisely, they compared two versions of the game. In the first version participants had to choose whether to trust another participant with an investment. In the second version, this choice was determined randomly by drawing a numbered ball from an urn. The results revealed that the oxytocin levels of the participants were nearly twice as high if they were entrusted with an investment, but only if it was done intentionally (as in the first version). Importantly, the average monetary transfers in the two versions was identical, indicating that it is not benefits per se that release oxytocin, but only signals of pro-social intentions. These two oxytocin studies suggest a neurochemical mechanism linked to the emergence of reciprocity. Oxytocin appears to be released by intentional pro-social acts, which in turn motivate pro-social behavior. Reciprocal social interaction may therefore arise due to emotional reactions to (perceived) mutual good intentions. In real life interactions this simple mechanism is obviously also useful in various forms of deceptions and manipulation, e.g. in the science fiction-like concept of spraying oxytocin in a board room (Damasio 2005), and, in more realistic situations, intentional manipulations of the perceptions of the interaction.

The idea that reciprocity may be grounded in emotions is also supported by an earlier fMRI-study conducted by Rilling et al. (2002). Players engaged in mutual cooperation showed significantly increased activation in neural circuits that have been linked to reward processing (e.g. nucleus accumbens and the caudate nucleus). Furthermore, the activation in the reward centers increased with consecutive outcomes of mutual cooperation. This might seem surprising given that mutual cooperation is less profitable than cheating (defection-cooperation), but the authors interpret the effect as the neural foundation of a subjective emotional reinforcement of reciprocal interactions, which motivates us to resist the temptation to cheat. Thus, participants also considered mutual cooperation the most personally satisfying outcome.

Emotions and the importance of context

The studies cited above appear to lend empirical support to an important claim made by at least some social capital-theorists, namely that humans are not only directed by narrow self-interest. They are also at times motivated by notions of cooperation and of fairness. Importantly, both at the behavioral and the neuronal level, there seem to be particular markers of these traits. The links between experiencing unfairness and subsequent action appears to be ‘emotional’ in the sense that typical emotional regions in the brain become activated, and that particular interactive valence is attached to opponents who behave either unfairly or pro-socially. It is these observations about the importance of emotions that form the core message from neuroscience to the social capital literature. Furthermore, situations of cooperation entail, apparently, an interpretation of the opponent as intentional and human. We elaborate on these observations below.

It is a current trend in neuroscience to study emotions as fundamental motivating forces in human decision-making (Damasio, 1994, 2004; LeDoux, 1996). We can conceptualize the emotions evoked in the studies described above (such as sympathy, anger and disgust) as belonging to a category of *moral emotions* due to their ability to promote unselfish behavior (Haidt, 2003). Important brain regions activated when such emotions are evoked are the amygdala, various subcortical nuclei and the insula (Moll, et al, 2002). Interestingly, people are seemingly often unaware of the processes leading to the execution of these emotions (LeDoux, 1996). This might relate to the fact that the sites vital to emotional processing are buried deep beneath the brain centers involved in controlled, conscious processing such as the prefrontal cortex (Lieberman, 2003). This lends support to the claim that behavior in dilemmas of cooperation is not always motivated by conscious assessments of self-interest.

When emotions are introduced into the equation, it not only becomes necessary to acknowledge the existence of moral motives; one must also acknowledge the endogenous nature of these motivations. In the words of Damasio (2004: 58), one may conceive of the brain regions for the elicitation of such specific emotions as 'locks that open only if the appropriate keys fit', the keys being the stimuli present in a situation (see also Damasio, 1994; Gazzaniga et al, 2002; LeDoux, 1996; Tooby, Cosmides & Barrett, 2005). This means that the emotions of interest here are motivational *states* rather than *traits*, that is, they emerge at a given moment in a particular situation. In this way, the emotions, which neuroscience documents as an important ingredient in decision-making, are something very different from the preferences in rational choice theory. Where preferences generally are conceived to be both exogenous to the decision-making context and stable across situations (see e.g. Shepsle, 1989), emotionally grounded motivations are triggered by the very context in which a decision is made.

As the emotional system is highly context-sensitive, we should expect moral emotions to be operative only under particular circumstances. As described above, a basic method in neuroeconomical studies is to compare brain activity when subjects play against a human partner with the activity elicited when they play against a computer. Apart from the experimental heuristics of this approach, it also provides substantial information about the context specificity of the experience of interactive exchanges. In the experiments discussed above, human-computer interactions elicit moral response to a lesser extent than do human-human interactions. In the McCabe et al. (2001) study of the prisoner's dilemma, the activity of cooperators in the prefrontal cortex, a region involved in inhibiting impulses (see also Knoch et al, 2006), is only higher in human-human interactions compared to human-computer interactions. Highly uneven offers made by computers in the ultimatum game appear not to activate anger and disgust patterns (Sanfey et al, 2003), nor do subjects feel pleasure when they reject such offers (de Quervain et al., 2004, see discussion of this experiment below). Interestingly, this contextual understanding of an interaction is not necessarily the result of a 'correct' reading of the situation. This is exemplified in Gallagher et al.'s study of intentional stance by way of a rock-paper-scissors game (2002). Subjects where here led to believe that they either played against a rule-bound computer program or a human opponent, when during scanning they actually played a random sequence. Both the experience of the game as validated by interviews and the brain activity recorded by PET scanning pointed to a marked difference between these two conditions. As expressed by one subject: "I could clearly feel the other person there, whereas I felt nothing from the computer".

The crucial question is how these human-computer interactions should be interpreted. Blount (1995) was among the first to investigate such interactions through behavioral observations. She claims that people reason about computer behavior in the same way they reason about environmental events, that is, as produced by chance rather than by the good or bad intentions of humans (although, along the lines of the Gallagher et al. finding, this difference may be a result of the contextual framing rather than the 'real' nature of the interaction [see also Jack & Roepstorff 2002]). This interpretation is reinforced by a recent brain-imaging study investigating human-computer interactions in more detail. In this study, Rilling et al. (2004) shows that areas involved in figuring out the intentions of others (anterior paracingulate cortex and superior temporal sulcus) can also – under the right circumstances – be activated when playing what is perceived to be a computer opponent. Thus, a prisoner's dilemma game where the response of the computer was contingent upon the response of the subject showed much more 'human interaction like' patterns than an ultimatum game (Rilling et al., 2004). In tandem, these observations imply that the putative ascription of morality to an interaction depends on a (not necessarily consciously made) contextual analysis of an interaction as 'human' (and that it may be a matter of degree rather than kind). Further, behavioral data suggest that this contextual analysis also involves asking questions about matters of obligation. Thus, in the ultimatum game participants share the understanding that endowments won in a quiz should not be split as evenly as endowments provisionally distributed by the experimenter (Hoffman McCabe, Shachat & Smith, 1994). When endowments are earned rather than assigned, people seem to feel less obligated to consider the interests of others.

In sum, the elicitation of moral emotions appears related to contexts where the opponent is perceived, first, as capable of understanding the situation from more than one perspective; second, as capable of acting with a certain level of freedom; and third, as obligated to take into account the act's welfare consequences for other people. Morality is thus a matter of framing, and as institutions and political developments foster relevant frames on certain issues or domains, they effectively become part of a moral economy. The market is a classic example of a context in which one is largely allowed to act without considering the general welfare consequences of one's acts. In line with this, a large literature shows how moral motivations are 'crowded out' when social exchanges are moved from a non-market context and into a market context (Frey, 1997; Le Grand, 2003). For example, people may be more willing to donate blood if they are *not* paid to do so, that is, when it is a gift rather than an exchange on the market (Titmuss, 1970). Similarly, interactions can be moved into a moral domain by fostering the expectation that people are obligated to consider these interactions from the perspective of others and revise their acts if there is a potential for negative impacts on the welfare of others. Smoking is a clear example (see Rozin & Singh, 1999). Over a decade political campaigns have transformed smoking from a non-issue into a moral one, in which the smoker is obligated to consider how his vice impacts bystanders. If he fails to do so, reactions of anger and disgust are quickly elicited. Another example of direct relevance to social capital literature is environmental behavior which the advent of post-materialistic values has moved into a trust-regulated moral domain (see Sønderskov, 2008). In this way, the neuroeconomic experiments described here underscore the claim of some social capital theorists regarding the importance of the institutional context for human motivations (e.g. Ostrom, 1998). An implication of this perspective is that a certain reservoir of social capital is probably not sufficient to guarantee collective action. A likely necessary condition is that the problem is perceived as a moral matter, in which the intertwinement of people's interests and their capability and obligation to act accordingly is clear.

Conclusion

In this chapter, we have reviewed a series of studies in neuroeconomics. These studies demonstrate that reciprocal social interactions are, psychologically speaking, motivated by emotional dynamics that emerge outside conscious awareness in situations where the participants are mutually perceived as capable of and obligated to consider each other's interests. Neuroeconomics thus sheds light on the psychological basis of cooperation and, furthermore, points to important conditions that must be fulfilled for cooperation to emerge.

This conclusion can be taken as support for the relevance of the social capital tradition. Although operating at very different levels, both the social capital and the neuroeconomic approach reject, partly on experimental grounds, partly on theoretical ones, a simple ‘rational man’ approach, in which decisions are based solely on short-term selfish calculations. In addition, both approaches identify elements like trust and reciprocity as central explanatory variables in group behavior as well as in individual actions. The significance of trust, reciprocity and emotion in neuroeconomic studies indicates that these phenomena are more than just artificial consequences of selfish and rational motivations. When another human being trusts you, it is not necessarily because he is confident that you cannot afford to renege on your promise. And if you do so, he will probably feel angry, and perhaps even make a costly effort to get revenge. If you return a favor, reciprocate, your motivation is likely to be a feeling of obligation or desire to do so, and not just a calculation that it will pay off. The social capital approach operates with concepts that are more than rationality in disguise and they are essential to understanding human behavior. However, the social capital approach is also diverse. While the conclusion about the importance of context-sensitive emotions will be in line with some perspectives in the social capital tradition, it might be at odds with other more rationalistic approaches to social capital.

In one reading of these parallels between social capital and neuroeconomics, current neuroeconomics proves ‘social capital theory’ right in that the key concepts of the approach, trust, emotions, and reciprocity, are found in the brain. The problem with such an interpretation is that it uncritically links two very different levels of explanation where concepts take on very different meanings, while bracketing out the epistemological and ontological differences that separate these levels. For instance, the finding about the link between oxytocin and cooperation is intriguing, but like much current neuroeconomic research it cries out for proper contextualization. It can be taken along a path of radical reductionism, as illustrated by Zak and Fakhar (2006), who claim to identify cross-national correlations between the consumption of plant based estrogens, a precursor of oxytocin, and levels of trust. In a mild reductionism, Damasio (op.cit.) suggests that current marketing techniques may provide stimuli that naturally release oxytocin. It would also lend itself nicely to a social capital explanation; if trust is about social capital and social capital is about a particular social and interpersonal context, and oxytocin is released in particular contexts, for example in social bonding processes (Uvnäs-Moberg, Arn & Magnusson, 2005), then social capital may be all about creating an environment that triggers the release of oxytocin. However, a satisfying explanation must look into how decision making emerges in a balance between these different factors and how it merges with contextual evaluations and the experience and exertion of agency. That level of neurobiological explanation has yet to be achieved and it may be a long way down the line.

Although the current state of cognitive neuroscience allows us to emphasize the importance of emotion, a basic problem is that the approach as such does not provide the tools required to develop more comprehensive understandings of these emotions. Our knowledge of neural processes is still (and may always be) too limited to help us infer the answers to questions such as 'how are specific emotional system structured?', 'when are they elicited?' and 'what kind of motivations do they foster?' simply by examining patterns of brain activity. Thus, to be able to venture deeper into exactly how emotions form the backbone of social cooperation, we are in need of meta-theoretical guidance.

Different possibilities suggest themselves. One might look to the discipline of evolutionary psychology, where emotions are described as biological information processing systems that evolved to help our ancestors deal with recurrent reproductive problems (Tooby & Cosmides, 1990; Cosmides & Tooby, 2000). Through knowledge of ancestral environments, evolutionary processes and the structure of the recurrent problems, this approach may offer detailed hypotheses about the architecture of human emotions and the situations in which they are elicited (Barkow, Tooby & Cosmides, 1992). Another possible way forward would involve a more sociological focus on actual persons, how they interact, and how configurations of the social interact with the biological (Latour 2006, Rose 2006). Our review of the literature suggests that trust and reciprocity are highly contextual elements that appear to be applied only in particular reflexive situations of interaction. They occur when person A interact with another person B and A imagines that B is in a situation where she can a) take A's position into account and b) act with that in mind. While this acknowledges how particular biological configurations allow humans to construct others as persons equipped with perspective taking, intentionality, emotions, etc. (Frith & Frith 1999, 2006), it stresses how the identification of key social capital effects like trust and reciprocity, both at the level of brains and interactions, are consequences of reflexive sociality in action.

References

Ahn, T.K., E. Ostrom, D. Schmidt, R. Shupp and J. Warker. (2001). “Co-operation in PD games, fear, greed and history of play.” *Public Choice*, 106:137–155.

Arrow, Kenneth J. (2000), “Observations on Social Capital”, in Partha Dasgupta & Ismail Serageldin (eds.), *Social Capital. A Multifaceted Perspective*, Washington D.C.: The World Bank.

Barkow, Jerome H., Leda Cosmides & John Tooby (eds.) (1992). *The Adapted Mind*, Oxford: Oxford University Press.

Blount, Sally (1995). "When Social Outcomes Aren't Fair: The Effect of Causal Attributions on Preferences", *Organizational Behavior and Human Decision Processes*, 63, 2, pp. 131-144.

Camerer, Colin, Loewenstein, George & Prelec, Drazen (2005). “Neuroeconomics: How neuroscience can inform economics.” *Journal of Economic Literature*, vol. 43 (1), 9-64.

Cameron, Lisa (1999). Raising the stakes in the ultimatum game: experimental evidence from Indonesia, *Economic Inquiry*, 37: 47-59

Coleman, J. S. (1988) "Social Capital in the Creation of Human-Capital." *American Journal of Sociology*, 94, pp. S95-S120.

Cosmides, Leda & John Tooby (2000). "Evolutionary Psychology and the Emotions", pp. 91-115 in Michael Lewis & Jeannette M. Haviland-Jones, *Handbook of Emotions. Second Edition*, New York & London: Guilford Press.

Damasio, Antonio (1994). *Descartes' Error*, New York: HarperCollins Books.

Damasio, Antonio (2004). *Looking for Spinoza* Vintage.

Damasio, Antonio. (2005). Human behaviour: Brain Trust. *Nature* 435, 571-2.

de Quervain, Dominique J. F., Urs Fischbacher, Valerie Treyer, Melanie Schellhammer, Schnyder Ulrich, Alfred Buck & Ernst Fehr (2004). "The Neural Basis of Altruistic Punishment", *Science*, 305, 1254-1258.

Fehr, Ernst. (2004). The productivity of failures. *Nature* 428, 701.

Frackowiak, R.S.J. et al, (2004) (eds.) *Human brain function*, Boston: Elsevier Academic Press.

Frey, Bruno S. (1997). Not Just for the Money. An Economic Theory of Personal Motivation. Cheltenham, Brookfield: Edward Elgar Publishing

Friedman, Milton (1953), *Essays in Positive Economics*, Chicago: University of Chicago Press

Frith, C.D. & U. Frith. (1999). Interacting minds--a biological basis. *Science* 286, 1692-5.

Frith, C.D. & U. Frith. (2006). How we predict what other people are going to do. *Brain Research* 1079, 36-46.

Gallagher, H., A.I. Jack, A. Roepstorff & C.D. Frith (2002). Imagining the Intentional Stance in a Competitive Game. *NeuroImage* 16, 814-21.

Gallagher, H.L. & C.D. Frith (2003). Functional imaging of 'theory of mind'. *Trends in Cognitive Science* 7, 77-83.

Gazzaniga, M. S., R. Ivry & G. R. Mangun (2002). *Cognitive Neuroscience: The Biology of the Mind*, 2nd Edition, London & New York: W.W. Norton.

Glimcher, Paul (2003). *Decisions, Uncertainty, and the Brain. The Science of Neuroeconomics*. Cambridge, Mass.: The MIT Press.

Güth, Werner, Rolf Schmittberger & Bernd Schwarze (1982), “An Experimental Analysis of Ultimatum Bargaining”, *Journal of Economic Behavior and Organization*, 3, pp. 367-388

Haidt, Jonathan (2003). "The Moral Emotions", pp. 852-870 in Richard J. Davidson, Klaus R. Scherer & H. Hill Goldsmith (red.), *Handbook of Affective Sciences*, Oxford: Oxford University Press.

Harris, Lasana T. & Fiske, Susan T. (2006). “Dehumanizing the Lowest of the Low: Neuroimaging Responses to Extreme Out-Groups.” *Psychological Science*, vol. 17 (10), 847–853.
Hoffman Elizabeth, McCabe, Kevin, Shachat, Keith & Smith Vernon (1994). “Preferences, Property Rights, and Anonymity in Bargaining Games”, *Games and Economic Behavior*, vol. 7 (3), 346-380.
Inglehart, Ronald, Miguel Basánez, Jaime Díez-Medrano, Loek Halmann and Ruud Luijkx (eds.) (2004), *Human Beliefs and Values. A cross-cultural sourcebook based on the 1999-2002 values surveys*. Coyoacan: Siglo XXI Editores
Jack, A.I. & A. Roepstorff (2002). Introspection and Cognitive Brain Mapping: from Stimulus-Response to Script-Report. *Trends in Cognitive Sciences* 6, 333-339.
Knack, Stephen, and Philip Keefer (1997). “Does Social Capital Have an Economic Payoff? A Cross-Country Investigation”, *Quarterly Journal of Economics*, 112 (4), pp. 1251-1288.
Knoch, Daria, Alvaro Pascual-Leone, Kaspar Meyer, Valerie Treyer & Ernst Fehr (2006). "Diminishing Reciprocal Fairness by Disrupting the Right Prefrontal Cortex", *Science*, 314, pp. 829-832.
Kosfeld, M., M. Heinrichs, P.J. Zak, U. Fischbacher & E. Fehr (2005). Oxytocin increases trust in humans. *Nature* 435, 673-6.
Latour, B. (2006). *Reassembling the social. An introduction to actor-network theory*. Oxford: Oxford University Press.
Le Grand, Julian (2003). Motivation, Agency, and Public Policy. Of Knights and Knaves, Pawns and Queens, Oxford: Oxford University Press
LeDoux, Joseph (1996). *The Emotional Brain*, New York: Touchstone.
Lieberman, M. D., Schreiber, D., & Ochsner, K. N. (2003). “Is political thinking like riding a bicycle? How cognitive neuroscience can inform research on political thinking.” *Political Psychology,* vol. 24, 681-704.
Lieberman, Matthew D. (2003). "Reflective and reflexive judgment processes: A social cognitive neuroscience approach", pp. 44-67 in J. P Forgas, K. R. Williams & W. von Hippel (Eds.), *Social judgments: Implicit and explicit processes*, New York: Cambridge University Press.
McCabe, Kevin, Daniel Houser, Lee Ryan, Vernon Smith & Theodore Trouard (2001). "A functional imaging study of cooperation in two-person reciprocal exchange", *Proceedings of the National Academy of Science,* 98, 20, pp. 11832-11835.
Moll, Jorge, Ricardo de Oliveira-Souza, Paul J. Eslinger, Ivanei E. Bramati, Janaina Mourao-Miranda, Pedro Angelo Andreiuolo & Luiz Pessoa (2002). "The Neural Correlates of Moral Sensitivity: A Functional Magnetic Resonance Imaging Investigation of Basic and Moral Emotions", *The Journal of Neuroscience,* 22, 7, pp. 2730-2736.
Morris, James P., Squires, Nancy K., Taber, Charles S., Lodge, Milton (2003). “Activation of Political Attitudes: A Psychophysiological Examination of the Hot Cognition Hypothesis”, *Political Psychology*, vol. 24 (4), 727–745.
Ostrom, Elinor (1998). "A Behavioral Approach to the Rational Choice Theory of Collective Action: Presidential Address, American Political Science Association", *American Political Science Review,* 92, pp. 1-22.
Paldam, Martin. and Svendsen, Gert. T., (forthcoming). *Trust, Social Capital and Economic Growth: An International Comparison*. Edward Elgar, Cheltenham, UK
Persinger, Michael A. & Healey, Faye (2002). “Experimental Facilitation of the Sensed Presence: Possible Intercalation between Hemispheres Induced by Complex Magnetic Fields.” *The Journal of Nervous and Mental Diseases*, vol. 190 (8), 533-541.
Portes, A. (1998), "Social Capital: Its Origins and Applications in Modern Sociology", *Annual Review of Sociology,* 24, pp. 1-24.

Poulsen, A., Svendsen, G.T. (2005), "Social capital and endogenous preferences", *Public Choice,* vol. 123 nr. 1-2, s. 171-196

Putnam, Robert D. (1993a), *Making Democracy Work: Civic Traditions in Modern Italy*, Princeton: Princeton University Press

Putnam, Robert D. (1993b), “The Prosperous Community. Social Capital and Public Life”, *American Prospect*, vol. 4 (13), pp. 35-42

Rilling, James K., Alan G. Sanfey, Jessica A. Aronson, Leigh E. Nystrom & Jonathan D. Cohen (2004). "The neural correlates of theory of mind within interpersonal interactions", *NeuroImage*, 22, pp. 1694-1703.

Rilling, James K., David A. Gutman, Thorsten R. Zeh, Giuseppe Pagnoni, Gregory S. Berns and Clinton D. Kilts (2002). “A Neural Basis for Social Cooperation”, *Neuron*, 35, pp. 395-405.

Rose, N. (2006). The politics of life itself. Biomedicine, power and subjectivity in the twenty first century. Princeton: Princeton University Press.

Roth, Alvin E., Vesna Prasnikar, Masahiro Okuno-Fujiwara & Shmuel Zamir (1991). “Bargaining and Market Behavior in Jerusalem, Ljubljana, Pittsburgh, and Tokyo: An Experimental Study, *American Economic Review*, 81: 1068-1095.

Rozin, Paul & Singh, Leher (1999): “The Moralization of Cigarette Smoking in the United States”, Journal of Consumer Psychology, vol. 8 (3), pp. 321-337.

Sanfey, Alan G., James K. Rilling, Jessica A. Aronson, Leigh E. Nystrom & Jonathan D. Cohen (2003). "The Neural Basis of Economic Decision-Making in the Ultimatum Game", *Science,* 300, pp. 1755-1758.

Saver, Jeffrey L. & Rabin, John (1997). “The Neural Substrates of Religious Experience.” *Journal of Neuropsychiatry*, vol. 9 (3), 498-510.

Shepsle, Kenneth A. (1989). ”Studying Institutions. Some Lessons from the Rational Choice Approach”, *Journal of Theoretical Politics*, vol. 1 (2), pp. 131-147

Singer, T., B. Seymour, J.P. O'Doherty, K.E. Stephan, R.J. Dolan & C.D. Frith (2006). Empathic neural responses are modulated by the perceived fairness of others. *Nature* 439, 466-9.

Sobel, J. (2002), "Can We Trust Social Capital?" *Journal of Economic Literature*, 40 (1), pp. 139-54.

Sønderskov, Kim M. (2008), “Environmental group membership, collective action and generalised trust”, Environmental Politics, 17 (1), pp. 78-94

Titmuss, Richard M. (1970). The gift relationship: from human blood to social policy. London: Allen and Unwin.

Tooby, John & Leda Cosmides (1990). "The Past Explains the Present: Emotional Adaptations and the Structure of Ancestral Environments", *Ethology and Sociobiology*, 11, pp. 375-424.

Tooby, John, Leda Cosmides & H. Clark Barrett (2005). "Resolving the Debate on Innate Ideas", pp. 305-337 i Peter Carruthers, Laurence S. & Steve Stich (red.), *The Innate Mind: Structure and Content*, New York: Oxford University Press.

Uvnäs-Moberg, Kerstin, Arn, Ingemar & Magnusson, David (2005). “The Psychobiology of Emotion: The Role of the Oxytocinergic System.” *International Journal of Behavioral Medicine*, vol. 12 (2), 59-65.

Wildavsky, Aaron (1993), “Why Self-Interest Means Less Outside of a Social Context: Cultural Contributions to a Theory of Rational Choices”, *Journal of Theoretical Politics*, 6 (2), pp. 131-159

Yamagishi, Toshio (1988), “The Provision of a Sanctioning System in the United States and Japan”, *Social Psychology Quarterly*, 51 (3), pp. 265-271

Zak, P.J. & A. Fakhar (2006). ”Neuroactive hormones and interpersonal trust: international evidence”, *Economics & Human Biology*, 4, pp. 412-29.

Zak, Paul J., Robert Kurzban & William T. Matzner (2004). “The Neurobiology of Trust”, *Annals of the New York Academy of Sciences*, 1032, pp. 224-227.