Frankfurt School – Working Paper Series

No. 128

Outline of a Darwinian Theory of Money

by Carsten Herrmann-Pillath

Oktober 2009

Presented at the *Annual Conference of the European Association for Evolutionary Political Economy*, Amsterdam School of Economics, November 6-8, 2009

Sonnemannstr. 9 – 11 60314 Frankfurt am Main, Germany
Phone: +49 (0) 69 154 008 0 Fax: +49 (0) 69 154 008 728
Internet: *www.frankfurt-school.de*

Abstract

Building on Lea and Webley's drug theory of money, the paper connects different theoretical resources to develop a Darwinian theory of money. The central empirical observation is the neuroeconomic result of the independent role of money as a reinforcer, which matches with a series of other insights into strong emotional impact of money use. Lea and Webley proposed that money piggybacks on a generalized instinct for social exchange. I put this into the more universal framework of the Darwinian concept of signal selection and Aunger's theory of neuromemes. This can be related to Searle's theory of institutions, especially with regard to his notion of neurophysiological dispositions as a basis for rule-following. Thus, neuroeconomics and institutional theory can be put into one coherent framework of Generalized Darwinism, taking money and its emergence as a case study

Key words: Money emotions, Searle's theory of institutions, conceptual blending, emergence of money, neuronal Darwinism

JEL classification: B52, D03, D58, E40

ISSN: 14369753

Contact:

Carsten Herrmann-Pillath
Academic Director, East-West Centre for Business
Studies and Cultural Science
Frankfurt School of Finance and Management
Sonnemannstraße 9-11
60314 Frankfurt am Main, Germany
Email c.herrmann-pillath@frankfurt-school.de

Content

1 The problem: Money emotions – what are their implications for the theory of money?

There are worlds apart between the theoretical notions of money in economics and the complex and multifarious ways in which money is deeply enmeshed with social relations and social action in societies and economies, as we experience them in everyday life. In the recent financial crisis, this dual nature came to the fore again when the financial industry was facing increasingly hostile public opinion pinpointing the perceived bankers' greed and irresponsibility. Indeed, money moves the world, and most people maintain particular emotional stances towards money, reaching from benign neglect to adoration. All societies manifest normative regulations of money use, in particular with regard to certain taboo zones, such as prostitution and organ trade. The theory based economic approach to market design has to heed attention to the very fact of 'repugnant trades' (Roth 2008: 286)

Looking at the activities involving the 'money professions', recent anthropological and sociological research has shown that financial trading is a far cry from being a purely rational-calculative concern (Zaloom 2003; 2004). Trading financial assets involves very strong feelings and requires a special emotional discipline, which, however, does not simply mean to suppress emotions, which are absolutely necessary to raise the alertness and aggressiveness indispensible to successful trading. Making money often shows a resemblance to making sex, highly exciting, but also highly dangerous, in the sense of financial ruin or social and physical havoc (sexual diseases, unwanted pregnancy etc.) (Seabright 2004: 76). This is reflected in the language and the habits of traders' communities (Hassoun 2005). After all, the financial business is also highly gender-biased with a very pronounced male dominance (Klaes et al. 2007). Recently, those affectual underpinnings have been related to different testosterone levels in both male and female traders affecting their relative professional success (Maestripieri et al. 2009).

Thus, rationality in financial trading does not appear to be a given capability of the universally rational individual, but results from special emotional disciplines and techniques of self-management that both contain and exploit underlying affectual drives (Preda 2008: 918). This can also be seen in the larger context of historical sociology, which reveals how the investor as a particular kind of personality emerged in the 19th century (Preda 2005). In an even

broader perspective, the emergence of modern capitalism was accompanied by strong reactions in religion and folk beliefs, often resulting in a demonization of money. Against this background, Max Weber's account of the rise of capitalism acquires a new meaning, as he had argued that Calvinism inspired its believers with a particular emotional stance towards money. As an expression of 'innerworldly ascetism', Calvinists were able to pair the acquisitive drive with abstention from lavishly spending it, thus launching the machine of accumulation in early capitalism.

These sketchy observations clearly underline what is evident from our everyday experience: Money causes strong emotions, and using and spending money has an emotional basis. Yet, in economics emotions normally do not play a role in theoretical explanations. In the case of money, theory is even more antiseptic, as money is mainly a veil, that is, a device purely used to ease transactions, without any independent utility. How can a veil cause such strong emotions? Something important is missing in the economics of money. Subsequently, I shall argue that this is the causal link between money as an artefact and neurophysiological processes in the human brain. That is, I present a naturalistic approach to money (on naturalism in general, see Papineau 2007)

In this paper, I wish to outline a theory of money that puts emotions at the centre. I use the concept of emotions in the sense of evolutionary psychology. Thus, I venture to outline a Darwinian theory of money. In doing that, I combine different theoretical resources, which I pick up one by one in the subsequent sections. In the next section, I briefly review the evidence that money comes close to a direct enforcer, which is provided by neuroeconomics. In section three, I analyse the institution of money against the background of Searle's theory of institutions. In this approach, institutions are embedded into language, and I propose a specification of this relation in terms of conceptual blending and the theory of metaphor. However, Searle also posits that the ultimate roots of institutions lie in neurophysiological dispositions, which matches the neuronal theory of metaphor in neurolinguistics. This link between language and neurophysiological processes can be exploited to connect the argument with psychologist's Lea and Webley's drug theory of money, which I analyse in section 4. The drug theory posits that money relates with a fundamental emotional structure, which I identify, in line with the Lea and Webley argument, with the social exchange related emotional complex as identified by evolutionary psychology. In the final section, I propose that these different

insights can be put into a coherent theoretical framework in Aunger's theory of neuromemetics, which emphasizes the interaction between external artefacts and neuronal processes in explaining cultural phenomena. This completes the naturalistic approach to money, and more specifically, the Darwinian theory of money. I take this as a model for a naturalistic approach to institutions along the lines of Generalized Darwinism (Hodgson 2002; Aldrich et al. 2008).

2 Money as a generalized direct reinforcer: The evidence from neuroeconomics and behavioural economics

Contrary to the economic theory of money, one of the important results of neuroeconomics is that money comes close to being a direct reinforcer. That means, money activates the same dopaminergic circuits in the human brain (more exactly, the mesolimbic system) as other items causing pleasure, such as beautiful faces (Camerer et al. 2005: 35). This simple fact is exploited in the work of psychologists, as money can be directly used as a generalized reward without further modification (Knutson and Wimmer 2007: 159f.). From that perspective, money is nothing special, as it just triggers general reward mechanisms in the human brain, possibly even involving a so-called 'common currency' (Landreth and Bickle 2008). There is no interference by an alleged purely instrumental role of money, which would imply that money would mean different rewards to people who might have different uses of money in mind when receiving the reward.

An interesting case in point is the asymmetry in loss aversion in experiments with gift certificates (Trepel et al. 2005: 41). If people are offered certificates for goods with different hedonic value, they choose them with equiprobability, but if they are asked to part with particular certificates, they respond exceptionally strong for those representing goods with higher hedonic value, thus manifesting a differential effect of loss aversion as compared to gains perception. Vice versa, such kind of asymmetry is also reflected in the tendency of people to avoid the pains caused by paying cash, such that they love to enter flat-rate payment arrangements in many areas or bonus schemes, which clearly simply hide what can be in effect a higher factual expense (Camerer et al. 2005: 36). This observation invalidates criticisms such as Harrison's (2008: 306f.) who argues that it is a common economic assumption in economics that the utility of money is equivalent to the basket of goods that can be purchased with money, as this would require strong cognitive capabilities of individuals and convergence

across different individuals. In game theoretic contexts, if money is taken as an equivalent to pay-offs in terms of utility, this is just a simplifying methodological assumption. The separateness of money in reward mechanisms is further proven by many other empirical results in behavioural finance and economics.

Before recounting these, one has to be careful with distinguishing between the two reward processing systems in the brain. If money activates the same dopaminergic circuits as other positively valued things, this refers to the so-called 'wanting' system, so there is a difference to the 'liking' system which refers to the actual consummation (Trepel et al. 2005; Brocas and Carrillo 2008). The wanting system underlies the processes that guide anticipatory planning and expectations. Clearly, we cannot eat money, so the actual consummation cannot cause the same effects as with other goods, but that is also true for every different commodity. If neuroeconomists relate the wanting system with a generalized notion of utility, the results concerning money could be simply translated into the proposition that money carries utility. Yet, this is not the ordinary assumption in economics.

The autonomous role of money as a reinforcer is related with important anomalies in behavioural economics and finance. For example, people loath the loss of cash dividends and do not net them out with capital gains, so cash seems to carry an additional value (see surveys such as Van der Saar 2004 or Subrahmanyam 2007). This can be explained by complex conceptual constructions, such as an interaction between loss aversion and hyperbolic discount curves. A present cash loss is weighted relatively strong against a future capital gain, even though the two might be equivalent for a rational decision maker. People organize their perceptions in different mental accounts for income and wealth, such that current income shows a disproportionally strong impact on consumption behaviour, as compared to the predictions of rational choice theory (surveyed in Akerlof 2007). Thus, people seem to need a special approach to manage money in the narrow sense, that is, cash, which is deeply grounded in social norms and expectations. Lack of control in spending money is often seen as a lack of self-control. The special meaning of cash in those systems of behavioural regulation can be also gleaned from the fact that credit cards seem to loosen those constraints, presumably because they have different effects in the context of hyperbolic discount curves, combined with loss aversion (Laibson 1997).

These observations are also related to the equity premium puzzle, which has been explained by moving reference points with regard to dividend payments, as opposed to capital gains. If reference points move, different degrees of loss aversion are implied, thus explaining the additional risk premium necessary to make the trades equal. If this explanation is valid, however, this implies that money activates the neuronal mechanisms underlying frame-dependent loss aversion (Knutson et al. 2008), whereas the more complex accounting constructs of capital gains and losses do not. The same monetary values trigger different neuronal responses, depending on their representation.

The clearest proof, also confirmed by brain research recently, for the independent reward triggered by money is money illusion. The existence of money illusion has been confirmed by psychological research beyond any doubt (Shafir et al. 1997). For example, people normally report higher satisfaction with deals involving higher nominal quantities of money to deals with lower ones, even if, in an inflationary setting, the real values are the same. In brain imaging studies, researchers could show that the reward circuits in the brain react much stronger with the higher nominal, yet identical real values (Weber et al. 2009).

To summarize, recent research in behavioural economics and neuroeconomics has shown that money can be seen as a direct reinforcer in the same way as other goods. Obtaining and keeping money satisfies a want that is *independent* from the derived need for money to obtain other goods. This implies that our standard conception of money may be misled by the assumption that money is a general purpose exchange medium. Although this use of money is part and parcel of the modern institution of money, it may not be at the core of the social fact. In other words, the transactional use of money might be a derived function, which is, however, prevalent in modern economies. So-called behavioural anomalies of money use can be explained by the fact that these two functions of money interact in social practice. Let us turn to the theory of the emergence of money to clarify this point.

3 The emergence of the institution of money

3.1 Emotions and institutions

If we accept that fact that money has a direct reflection in feelings, how can we relate this to the nature of money as an institution? This question is of immense theoretical importance because recent theorizing in institutional economics has brought cognition to the fore (e.g. Aoki 2001, 2007; North 2005). It is now widely accepted that institutions are not simply external arrangements of incentives, but built on cognitive models, such that formally similar institutions can trigger different behavioural performances, for example. In this sense, older NIE models of institutions were simply behaviouristic, based on a universally valid black box model of rational choice. Cutting edge theories follow up to the cognitive science turn in the 1960s, though belatedly (and forgetting historical precursors such as Veblen and is notion of 'habits of thought', see Hodgson 2004). Today, an institution is seen as a correlate between a set of external incentives and enforcement mechanisms on the one hand and a set of cognitive models on the other hand, such that institution-guided behaviour is always frame-dependent. Those frames are shared in a population of rule-followers. Their handling is shaped by psychological regularities such as those establed by Gestalt psychology (Schlicht 1998). However, in these cognitive theories in economics emotions are not taken into consideration, which seem to play a paramount role in the use of money, as we have seen.

This is not the place where I can discuss the immensely complex literature on cognition and emotion (with special reference to the notion of rationality, see Pham 2004, 2007). So I just posit one particular position. This is to define emotions as framed affects, such that the notion of the frame can serve as the conceptual bridge between the notions of emotions and institutions. In evolutionary psychology, emotions are seen as higher-order neuronal structures that coordinate sets of more elementary affectual circuits (Tooby and Cosmides 2005: 52ff.). As such, they are necessarily related with cognitive structures, in the sense that the coordination builds on pattern recognition in the environment. Thus, the emotional complex underlying fear of snakes is related with cognitive mechanisms of identifying snakes, including all possible transfers of meaning by metaphorical uses of the term etc.

This argument can be also inverted, in the sense that cognition presupposes affectual mechanisms which provide the ultimate standards of evaluation, which is, for instance, essential to select informational cues from the environment (cf. Damasio's 1996 notion of somatic markers; Pham 2007: 161ff.). From this follows, that cognitive approaches in institutional economics cannot work without taking emotions as a central category.

3.2 Searle's theory of institutions

The inclusion of emotions as a conceptual category can be achieved in the context of Searle's (1995, 2005) theory of institutions. Searle argues that institutionalized behaviour builds on behavioural dispositions, which are neurophysiologically anchored. Following a rule does not require knowing the rule as such, so there is no need for a fully fledged mental representation. It suffices to be able to process environmental clues which trigger neurophysiological reactions that produce the required behaviour. Thus, in Searle's theory institutions are not fully reflected in cognitive models, but in complex conjunctions of partial cognitive representations and affects, i.e. neurophysiological mechanisms. This viewpoint seems to be complementary to Aoki's (2001) notion of the stabilization of institutions by summary representations of the underlying game structures. Summary representations are partial cognitive models which do not need to be shared in a population, but still form part and parcel of the reproduction of the institution by means of coordinated behaviour, as long as pay-offs stabilize the different summary representations. Searle adds the important observation that the behavioural stability is rooted in affectual circuits, hence emotions as framed affects, in our sense.

This kind of prestructuration is the basis for the more general functionings that are involved in the emergence of institutions. According to Searle, these are, foremostly, the so-called status function and the power creation operator. The status function builds on language in a most general sense. In a status function, a certain entity is treated as another entity; hence a metaphorical relation is created, depending on a particular context. The status function has the general form:

<*X* counts as *Y* in context *C*>

For example, I can treat a piece of metal as 'money', which is different from just using that piece in a simple barter process in which the traders may have some generalized use for it. A status function involves a fundamental conceptual shift to another category of meanings. This is a linguistic activity because it cannot be done individually, as the use of the target concept depends on rules shared in a population of users of the concept (along Wittgensteinian lines).

Institutions presuppose collective intentionality in the sense that the status function must build on a collectively shared understanding. Once this has emerged, the metaphor gains in ontological validity and robustness, as it evolves into an observer-relative fact, the institution. So, if in a community of language users a certain metal is used as money, single individuals cannot change this use just by taking an autonomous decision. Similar to related approaches to collective intentionality (e.g. Tuomela 1995), Searle also assumes that these collective uses may build on power relations in a certain community, but one has to be aware of the fact that these themselves build on institutions. So, current institutions are a complex web of mutually supporting institutions, which can be traced back to some original situation where 'brute facts' counted more, in the sense, for example, that power relations may have been based on violence, or other physical facts. The distance between modern institutions and their incipient forms can be explained by the recursiveness of the status function, and can be compared to the etymological relations in language. That is, modern word use almost always goes back to past metaphors, yet this does not mean that those metaphors still determine our understanding of the meaning in terms of actual usages (Pinker 2007: Chapter 5). In the same way, a modern institution such as money evolved through a series of recursive status functions, ending up with different forms of money, for example, such as cash, giral accounts etc. Yet, it is a question of empirical inquiry whether primordial status functions still hold, which may directly relate institutions with 'brute facts' such as elementary biological functionings (as in the case of many religious symbols and institutions, see Burkert 1996). I argue that such 'brute facts' in the historical emergence can be still present in the emotional mechanisms underpinning an institution.

This brief sketch shows that Searle's theory can indeed offer a framework to analyse the role of emotions in the institution of money. I will specify this in two steps. My first step is to present a particular account of the historical emergence of money, offering an empirical interpre-

tation of the status function. The second step is to identify the corresponding affectual structures. This will be tackled in the next section.

3.3 The emergence of the money institution and conceptual blending

How can we further detail the workings of a status function? I propose to relate Searle's theory to Fauconnier and Turner's (2002; 2008) theory of conceptual blends. A conceptual blend is precisely this: Two concepts in different conceptual spaces are blended within a certain generic space, so that a new concept emerges, which may show also a new blend of pre-existing properties. A workhorse is the treatment of 'time as space' in most, if not all human languages and societies. Treating time as space allows conceptualizing time in a particular way, such that new concepts can be created, such as the journey. A journey, in turn, can become part of other conceptual blends, such as treating 'love as a journey.' This creates ontology of time which is clearly different from the physical notion of time.

We can use the notion of the conceptual blend to reconstruct the emergence of money. This is most interesting in our context, because there is a clear contradiction between established theories of the emergence and the historical facts. Purely theoretical accounts emphasize the role of money in enabling transactions, as in the triangular exchange paradigm. The classic, almost unsurpassed until today, is Menger's (1892) evolutionary account (for modern receptions, see e.g. Schotter 1982). In these accounts a certain item evolves as money for the pure function of serving as a transaction device. This also implies that basically, there is no conceptual transformation, in the sense of a status function, but only a growing functional salience of properties such as resaleability, storability and dividability. This explanation clearly fits into the established economic theory of money, but contradicts the historical evidence. In fact, money emerged in the context of relations of power and authority, regulating hierarchical exchange relations and the production of public goods, and only the further evolution was intermingled with the more haphazard use of valuable items in barter (for a survey of the evidence, see Chavas and Bromley 2008). The historical data suggest that the transactional function of money is in fact a derived function, thus corresponding to the hypothesis ventilated at the end of section 2. Hutter (1994) proposed an intriguing account of the historical facts that we can directly translate into the conceptual blend framework and into the status function

structure, which precisely models that derivative relation between pristine money and derived functions.

When money coins emerged for the first time in the Eastern Mediterranean (at least as far as Western civilization is concerned), this was an effect of cross-cultural merger of meanings between Assyrian culture and the Ionian peasant communities. In Assyria, gold served as an indicator of status and as a medium of wealth accumulation in a steeply stratified society. In the Greek communities, silver was used for ritual purposes and occasionally for exchange, which was mostly mediated via a number of items with less value in barter, thus corresponding to the Menger view. The first genuine coins originating from Lydia, however, were made from electrum, an alloy of silver and gold. Thus, they could be interpreted differently in the two societies, enabling cross-cultural exchange of signs and goods. Further, in order to test the quality of coins, people applied punchs resulting into punchmark, firstly unintendedly. Once the coins circulated, people discovered the possible use of the punchmarks as indicators of origin. From this moment onwards, the custom of coining emerged, with the incipient use of the punchmarks as signals. Hutter speaks of an oscillation between the notions of ‘signed metal’ and ‘metal sign.’ Soon, the new coins were reintegrated into the political and the religious realm when local regents adopted the institution of minting. Thus, the first coins appeared displaying the images of rulers and holy symbols.

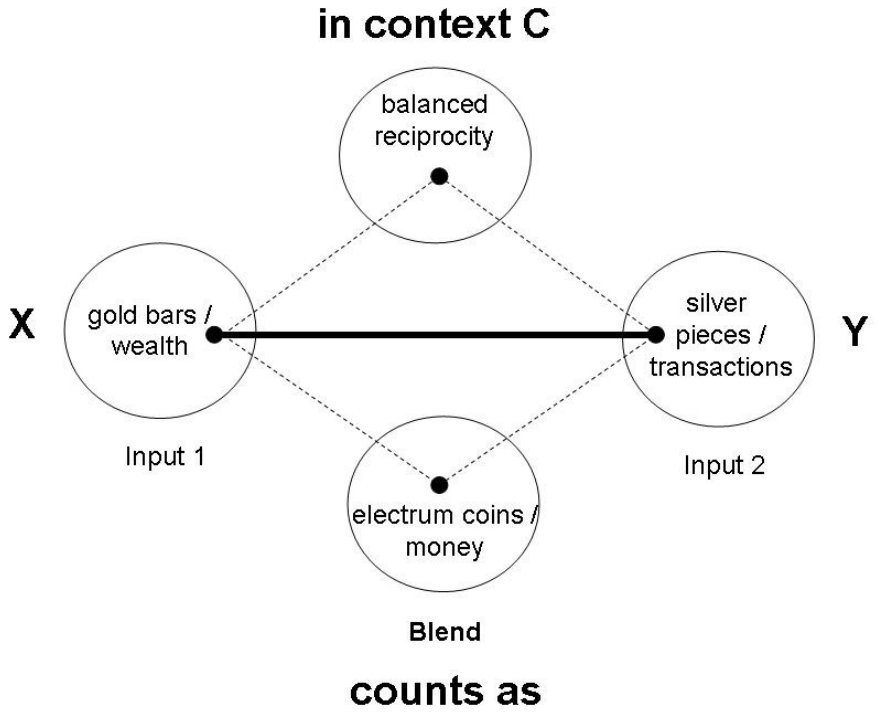

Fig. 1: Conceptual blending and status function in the emergence of money

Hutter's account easily can be translated into the framework of conceptual blends. Simultaneously, we can apply the status function notion. As we see in a standard Fauconnier and Turner notation merged with Searle's status function (fig. 1), the central point is that two different artefacts with different uses in different societies were merged into a common frame. This corresponds to a so-called 'double-scope integration network,' in which two concepts are only partially merged, as in the case of 'time as space', where the two notions bring in partial meanings into a blend, which, as a specific example, was the notion of a 'day' which relates to the generic space of circular motion. In a similar fashion, in the cross-cultural semantic ambiguity an alloy could be treated both as being close to a gold bar or a silver piece, thus also making those two artefacts commensurable, though only partially. In terms of the status function, in a double-scope integration network we can say that the status function in fact works in both directions, with 'gold' being treated as 'silver' and vice versa, in the context of

cross-cultural exchange, and being related to the 'brute fact' of the physical entity of electrum. In other words, the physical fact of an alloy enabled the creation of the status function. Once the status function was established, the institution of money, reified in the emergence of the first coins circulating in inter-regional trade, came into existence.

The question is what is the generic space that corresponds to the 'brute fact'? And how can we relate this cognitive process to emotive structures? I propose to use the notion of balanced reciprocity, which is both an abstract notion underlying ritualized power relations and of early exchange across longer time horizons (a classic on this is Pryor 1977: Chapters 4 and 7; Burkert 1996: Chapter 6). That means, money and balanced reciprocity are deeply interconnected, which seems to be an acceptable intuition. As we shall see now, this connection can be supported by recent research on the emotive foundations of money use.

4 Money, signal selection and balanced reciprocity

4.1 Perceptual drugs and signal selection

Psychologists Lea and Webley (2005) have recently proposed a 'drug and tool' theory of money. The upshot of their argument builds on empirical observations of the kind that I have sketched in the first section, that is, in their wording, money is a strong and universal incentive. Clearly, money is used as a tool in many contexts, that is, as a mere transaction device, but at the same times it manifests very strong emotional reactions in other contexts, and can trigger strong drives of acquisitive and hoarding behaviour. It is these drives that were thematized in the mythologies that emerged together with the early diffusion of money in the Mediterranean, recounting the fates of figures such as King Croesus. To grasp this phenomenon conceptually, the authors introduce the notion of a 'perceptual drug' which differs from a mere psychoactive drug such as nicotine. Perceptual drugs hijack an existing instinct or behavioural drive without actually satisfying the underlying adaptive biological functions. Thus, an instinct of sex may be triggered by certain erotic signals, yet without actually satisfying the underlying drive to reproduce. As a consequence, the trigger can result into a drug, even reinforcing the underlying behaviour, but without any biological value, and without a final consummation of the underlying drive.

This hypothesis can be supported by evolutionary reasoning. The interesting observation is that in the case of human beings, many activities can manifest the functioning of a perceptual drug, such as work, gambling or collecting stamps. We only need to come back to the aforementioned duality of wanting and liking to make sense of this, if we relate it to the theory of signal selection as stated by Zahavi and Zahavi (1997). The dualism of wanting and liking underlies the human capacity to plan and has phylogenetic roots in the evolution of the mammalian brain (overview in McCabe 2008: 354ff.). This, in turn, functionally requires representation, that is, builds on language, and more general on symbols that intervene in the causal process of eliciting goal-oriented behaviour (for more on that in a general evolutionary argument, see Dennett 1991 or Millikan 1989, 2005). Therefore, different from purely instinctual or reflexive reactions, human behaviour is systematically built on the distinction between the sign and the object. Thus, an apple is both an object and its sign. The signs play the crucial role in anticipatory reward mechanisms that underlies the 'wanting system'.

Now, the theory of signal selection implies that for arbitrary signs, the so-called handicap principle may apply, depending on the selective context. The handicap principle posits that the coordination of behaviour via signals may require the investment into costly signals which produces an adaptive disadvantage in the sense of natural selection (as opposed e.g. to sexual selection) (Dawkins 1989: 309ff.; Grafen 1990). Yet, precisely these costs make the signal functional, because otherwise it would be open to manipulation and cheating. That is, handicaps are truthful signals and because of that, are adaptive in terms of the universal currency of reproductive success. Yet, this implies the possibility of outright runaway processes which appear to be maladaptive, if only the pure engineering standards are applied, such as in the case of big antlers of deer that might hamper agility of movements.

In extension of the Lea and Webley approach, I posit that the handicap principle underlies also the emergence of perceptual drugs, elaborating on a suggestion of Ascoli and McCabe (2005) in their comment on the Lea and Webley paper. Ascoli and McCabe ponder whether the argument may hold for all scarce goods. An excellent example is eating. In times of scarcity of food, certainly prevalent throughout most of human phylogenetic past, the signs of food become exceptionally important for behavioural choices. This implies that the signs will also play a crucial role in behavioural coordination. Accordingly, food use is also governed by signal selection, ending up in the many examples of ritualized and very expensive and elabo-

rate food customs. If that is the case, however, the sign of food can also become a perceptual drug. As such, it underlies the many dysfunctions of eating. People who devour sweets without limits do not actually consume the sweets, but the signs of sweets, in this interpretation. In other words, even though food as such cannot be a psychoactive drug, it can become a perceptual drug, in which food symbols hijack the original adaptive drive for food acquisition.

4.2 Social exchange emotions as reference for the money artefact

So, a generalization of the Lea and Webley argument works via the adoption of the broader evolutionary framework of signal selection. This allows proposing a slight, yet essential modification of their central idea: which is, that the money drug piggybacks on an instinct to trade that evolved out of the universal mechanism of reciprocal altruism. More generally, we can point to the emotional patterns underlying social exchange that have been identified by evolutionary psychology (Cosmides and Tooby 2005, Ermer et al. 2006). Evolutionary psychology argues that the human species manifests a peculiar emotional structure that enables humans to maintain complex networks of social exchange based on reciprocity. Though reciprocity as such is a universal biological phenomenon (Trivers 1985: Chapter 3; Noë et al. 2001), the human species excels in terms of the generalization and the scope of exchange patterns (Seabright 2004). In these relations, both competitive and cooperative relations occur, often simultaneously, as modelled in game theoretic approaches towards egoistic cooperation (for example, in hunting large game, epitomized in Rousseau's stag hunt, see Skyrms 2004). As a result, modern evolutionary approaches to the development of the human brain posit the 'social brain' hypothesis (e.g. Dunbar and Shultz 2007; Frith 2007). Following up to earlier versions of Macchiavellian intelligence (Byrne 1995), this hypothesis states that the evolutionary more recent and innovative neuronal structures in the human brain are geared towards the organization and manipulation of social exchange.

From that perspective, money is an artefact and signal that triggers emotional responses related to social exchange in general. These are affects that relate with calculating mutual benefits across time, with detecting cheaters, or with perceiving mutual relations of indebtedness. Money as a perceptual drug mobilizes these emotional patterns, without actually satisfying them, which can only be done with executing the underlying exchanges (i.e. the 'liking' system). Yet, money triggers the same reward mechanisms (the 'wanting' system), which, acci-

dentally, also seem to be activated in the entirely different setting of PD dilemmas (Knutson and Wimmer 2007: 166). This seems to go back to the fact that the perception of cues to co-operation is tantamount to the perception of gains, i.e. rewards. Indeed, PD dilemmas also manifest social exchange relations, as it is evident from considering repeated games, which is the reasonable assumption for primordial human groups and trading communities. Therefore, the historical record that indicates the primary role of hierarchically embedded reciprocity in the emergence of money seems to match with the observation that evolutionary more ancient patterns of social exchange might not have been related with market-kind behaviour, but with exchange of contrived goods (Ofek 2001: Chapter 9). The complexity of exchange in these cases results precisely from the intermingling of exchange relations with cooperative behaviour, as in maintaining and sharing fire, or in hunting and sharing large game.

So, if money is a signal of that special kind, it is also open to the functioning of signal selection, especially with regard to the handicap principle. So it is easy to explain why the emergence of money was immediately connected with the appearance of extreme forms of accumulation and wealth display, as in Greek tyranny. In the original conceptual blend, money used for transactions and money used for storing and accumulating wealth were merged into one blend. This allows for a handicap mechanism to emerge, in the sense that the capability to hoard and display wealth is a marker of the capacity to spend limitless. The waste of wealth in useless displays is precisely the signal that communicates the capacity to enter a limitless number of transactions, thus claiming the role of a hub with exceptionally high prestige in ever-growing networks of exchange. This account matches the historical data in the sense that the purely technical uses of money emerged as a side effect of the primordial uses. Later, the runaway evolution of money also supported its rapid diffusion as a tool for transactions. This blend was epitomized in the emergence of the coin as an artefact for trade, but at the same time as a symbol for power and authority.

5 Completing the conceptual framework: Money as a meme

I will now try to put all my observations into one coherent theoretical framework, shifting the focus on general aspects of an evolutionary, hence Darwinian theory of money. So I embark on developing a theoretical case for Generalized Darwinism in the sense of Hodgson (2002) and others. This argument takes shape in the theory of neuromemetics as proposed by Aunger (2002). Originally, the theory of memes has been proposed by Dawkins (1989) as an approach to biology-culture co-evolution. Dawkins himself had suggested looking at culture as a meme pool, that is, a set of cultural items such as tunes, ideas, or dress styles. Those items were seen as replicators similar to genes, which, however, operate in another kind of environment, i.e. human brains. For meme reproduction, imitation is the central process (Blackmore 2000).

The theory has met with devasting criticism, because the direct analogy between genes and memes does not hold (e.g. Richerson and Boyd 2005: 80ff.), although the central role of imitation in the diffusion of cultural items has been further accentuated in recent research (Bentley and Shennan 2003). However, Aunger has presented another account which exactly matches our needs. My main motivation is to make further theoretical sense of the drug metaphor. On first sight, a drug seems to behave like a Dawkins-style meme, hijacking brains. However, given the weakness of the original concept, this promising venue cannot be taken unless the notion of the meme is fundamentally reconsidered.

The Aunger proposal is the following. We substitute the notion of the meme by the notion of the 'neurommeme.' The neurommeme is a replicative neuronal structure within the human brain, which is defined according to certain structural effects in the ongoing evolution of the neuronal architecture, both in the static and the dynamic sense. This proposal fits into established theories of neuronal selection, presaged in Campbell's (1960) seminal thinking (Edelman 1987, 2005; Calvin 1996, 1998; Hull et al. 2001). The specific mechanisms are still theoretical, but make empirical sense (see e.g. Fernando et al. 2008). Further, we can establish a direct connection with neurolinguistics, and especially to the neural theory of metaphor (Lakoff 2008). In the neural theory of metaphor, the notion of conceptual blending is directly related with a number of different kinds of structural patterns in neuronal activity, such as mappings between different brain areas, different types of circuitry etc. In other words, there is the assumption of a direct correspondence between networks of conceptual relations and neuronal

network patterns of activation (for a seminal perspective on that by an economist, see Hayek 1954; an exemplary approach is Strauss and Quinn 1997).

Now, neuromemes by definition do not reside outside the individual brain, so that there is no way to presume that neuromemes are the same across different brains. This differs fundamentally from the Dawkins conception: The neurometeme is a unit of neuronal evolution, but not of cultural evolution. They do not have meanings in the sense of culture, but are defined according to neuronal functionings. At the same time, neuronal evolution is a process that is basically independent from genetic evolution, in a similar way as the immune system evolves independently, although its basic structures are genetically shaped. That is, neuromemetics, following theories of neuronal selection and neuronal Darwinism, posits that gene-culture co-evolution is based on the simultaneous and interlocking runs of myriads of autonomous neuronal evolutionary sequences, with the neurometeme as the replicator. The extension to the notion of culture requires the introduction of another conceptual category. This is communication across brains, and, more specifically, artefacts.

Cultural meaning supervenes on communication across brains, which operates via artefacts. An artefact includes a broad range of physical phenomena, not only artefacts in the usual sense, but also, and foremostly, body signals such as the soundwaves of language or body movements. Artefacts are an essential part of a closed causal circuit which underlies the process of imitation in populations of brains. In recent theories about concept formation, the basic sensorimotoric feedback loop between motor outputs and the resulting sensory inputs, continuously matched with phylogenetically rooted valuation mechanisms, is the elementary unit from which more complex structures emerge (Hurley 2008). On the one hand, via output inhibition this builds the basis for the Vykotskian internalization of functionings. On the other hand, outputs can simultaneously be inputs into different brains, thus enabling double track feedback loops between Egos and Alters Outputs. Thus, a neurometeme causes a behavioural output, the artefact, which in turn triggers a neurometeme in another brain. This might elicit another output which feeds back into the originating brain. The convergence of outputs in terms of functionings results into a cross-brain coordination of neuromemes, without implying that the neuromemes have the similar structure across brains. In this framework, we can argue that signs emerge out of such feedback circuits, ending up in a convergence of artefacts. In other words, in Aunger's framework cultural evolution is a causally coupled co-evolution of

populations of neuromemes within individual brains and populations of artefacts, i.e. brain outputs (an abstract view on this is provided in fig. 2).

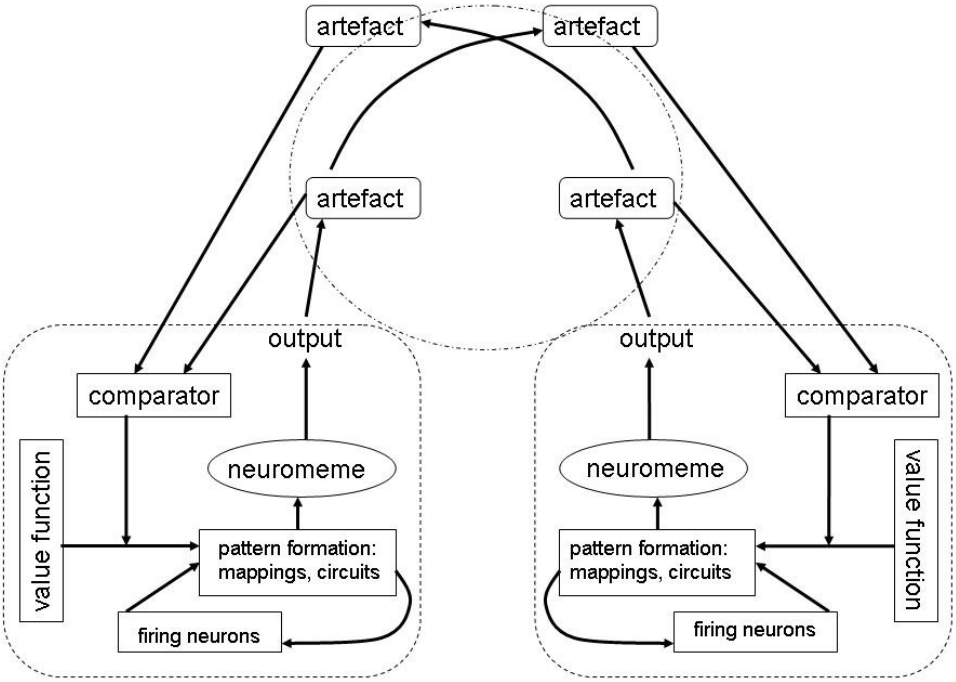

Fig. 2: Co-evolution of neuromemes and artefacts in a simple model of imitation (modified after Hurley 2008).

This viewpoint vindicates the more general externalist approach to mind, especially in the shape of theories on distributed cognition (Hutchins 1995; Sterelny 2004). The brain necessarily relies on a large and open range of external objects to achieve a stable equilibrium in what would be a chaotic fluctuation of neuronal firings otherwise. Contrary to Dawkins, culture cannot be equated with memes. But culture appears to be a set of artefacts which provide the stability and continuity so that the epistemic functionings of the brain can be scaffolded and leveraged. Culture, however, does not have a mentalist dimension here, though being causally interrelated with brain processes. If we were to continue with the use of the term

'meme', because it is a commonplace in many attempts at extending Darwinian analysis into other areas, we can redefine a meme as a stable conjunction of artefacts and neuromemes that evolve independent from each other, though being causally connected. The independence of the evolution of artefacts is a hypothesis that played an important role in older institutionalism (Ayres 1944) and has survived in modern theories about technological determinism. What we safely assert is that once artefacts evolved, they may follow an independent technological functionality in the sense that artefacts may technically interact with other artefacts, and that they allow for innovative feedbacks with other neuronal processes as the original ones. An important example is the invention of writing, which fundamentally changed the way how language can be used in human interactions, and opened up new ways of the organization of thought (Menary 2007).

Now, money is a case in point for this evolutionary dynamics. I propose that money is a meme in the sense of being an artefact that is closely conjoined with relatively fixed neuronal patterns that show up in a set of emotions governing behaviour in social exchange. It is important to emphasize its nature of an artefact, as has been evident in our account of the central role of the physical features of alloy in pristine money. Money is related with neuronal patterns underlying social exchange, so that mutually reinforcing causal feedback circuits emerged that further stabilized those human capacities, and open up the way for new expressions. Thus, with the diffusion of money its possible use as a transaction device was further strengthened, which in turn changed the context of social exchange towards the settings of more anonymous market-type relations. It is not the evolution of markets that required the emergence of money, but precisely to the opposite: The evolutionary emergence of an artefact with the properties of early money made the emergence and growth of markets possible, which is exactly the shift towards derivative functions of money.

6 Conclusion

The Darwinian theory of money establishes a conceptual linkage between different theoretical approaches. The pivotal point is Lea and Webley's theory of money as a perceptual drug. This can be embedded into two different theoretical contexts. One is already explicit in their approach, and is further expanded and generalized in this paper. This is the hypothesis that money relates with the fundamental human emotional complex governing social exchange

behaviour. I have shown that this relation can be further systematized by means of Aunger's theory of neuromemes, which is an extension of the general Darwinian paradigm. In this framework, the emergence of perceptual drugs can be explained by the theory of signal selection. The other theoretical context is Searle's theory of institutions, with special emphasis on his concept of neurophysiologically rooted dispositions to follow rules. This concept closes the circle between institutional theory and Darwinian Theory. Again, we can move on to more specific uses of Searle's theory, which I detail with the help of the theory of cognitive blending. All these elements taken together help to give a concise and convincing account of the emergence of money.

The Darwinian theory of money enables us to make sense of the empirical observations about the strong emotional components in handling money even in most advanced human societies. This does not imply, however, that those components always prevail. As we have seen, the notion of money as a meme is just shorthand for the conjunction of two independent dynamic processes. So, the artefact of money evolved historically in increasingly complex ways, thus strengthening functional and technological interdependencies. Therefore, actual money use today is governed by a mix of determinants, including also the 'rational' use of money without significant impact of primordial emotions. However, this means that those rational uses of money are not an outcome of the rationality of the human agent, but reflect the workings of external artefacts, such as institutions governing money markets, technologies governing money calculations in accounting, or new money artefacts such as electronic money. That is, the Darwinian theory of money is also an externalist account of economic rationality in the modern uses of money. Evolving artefacts may trigger "irrational uses" (such as in the credit card case, Laibson 1997) or "rational uses" (such as with the evolution of modern accounting systems, see Hatherly at al. 2008). So, the Darwinian theory of money also fits into the conceptual schemes that are emerging in economic sociology as an extension of social studies on science, especially in the context of social studies on finance (Preda 2008). Here, agency on financial markets is increasingly seen as resulting from complex networks of interaction between individual behaviour and embedding technologies (for pertinent collections of papers, see Callon et al. 2007; Pinch and Swedberg 2008). This is just a special expression of the general neurememe-artefact conjunction that was identified in this paper. Thus, even though the Darwinian theory of money is certainly illuminating on its own sake, its greatest value lies

in being just a wonderful case in point of what constitutes a general naturalistic and Darwinian theory of institutions.

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