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Neuroscience and Reductionism: Some Realist Reflections

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Abstract. Organizational neuroscience (ON) is a rapidly emerging sub-field. Criticisms of its reductionism are common. Yet it is possible for practitioners and critics to engage. Such engagement is facilitated by realism. It agrees with the practitioners of ON that brain functions can in principle be measured and that causal influences can be identified. It agrees with the critics in stressing the centrality of context and the emergent nature of social processes. The claims and potentials of ON can best be grasped through realist principles.

Key words: Emergence, Neuroscience, Organizational neuroscience, Realism

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The purpose of this short note is to reflect on the growing field of organizational neuroscience (ON) and what it can contribute to the understanding of social processes in organizations. The stance taken is realist, and the key point is that realism may be able to resolve some of differences between ON and its critics. ON has begun to make some large claims as to what it can explain. Such claims have produced a reaction, a central point of which is that ON is reductionist: it reduces complex and necessarily *social* processes not merely to individual mental states but to the physical operation of parts of the brain.¹ I agree with much of this reaction, but also want to suggest that much of the necessary critique of ON may deny some of the value of the approach. That value can be developed, however, only if ON specialists engage with their critics. Realism may permit such engagement. It can accept in principle that there are mental processes which are common to human beings and that affect our behaviour. This acceptance is based on one of its core ideas, that of entities: entities are things which make a difference, including molecules (O'Mahoney and Vincent, forthcoming; Fleetwood, 2005). But it also insists on at least two other core ideas. The first is context: the causal powers of mental processes and other forces operate in the context of other forces, so that a power may or may not be called into effect, and if it is called into effect it may be counteracted by other powers. The second is emergence: entities have causal powers that are greater than those of the sum of its parts, and hence we cannot reduce causal powers to those of the parts (Elder-Vass, 2010). O'Mahoney and Vincent (forthcoming) give the example of water, which has properties that cannot be reduced to those its constituent molecules. Context and emergence are issues that ON needs to recognize. The critics need to accept the idea of the causal power of the entities that ON is beginning to uncover.

An extremely terse summary of ON is given, merely to give the context. An equally brief view of conventional responses is then outlined. The argument then proceeds by qualifying the criticisms before using these qualifications to address the central issues in ON. The conclusion summarizes the value of a sociological dialogue with ON.

ON and Why it Matters

ON is the latest, and currently the most sophisticated, effort to understand how people behave in organizational settings by assessing the operation of their brains. As an application of neuroscience, it is claimed to address the 'primal causes' of behaviour (Becker et al., 2011: 934) which it does by using new techniques in psychology to scan brain activity. Neuroscience is, it is further claimed, 'beginning to allow direct measurement of thoughts and feelings' (Camerer et al., 2005: 10); the meaning of this claim is elucidated below. Importantly, it aims to do more than simply identify the basics of human mental functioning; it also uses its evidence to address such social phenomena as leadership. Waldman et al. (2011) for example measured the brain activity of 50 'leaders', correlated the measured 'coherence' between parts of the brain with the kinds of vision statements favoured by the leaders, and also showed that followers' perceptions of leaders were correlated with leadership styles.

Neuroscience itself is explained clearly from a social science point of view by Camerer et al. (2005). Yet when they say that we can directly measure thoughts, they should really be saying that we can measure electric impulses and may be able from the pattern of these impulses to infer something about brain activity. How far such physical activity tells us about

¹ An early exemplar of the idea is the science fiction of Isaac Asimov, whose three-volume *Foundation Trilogy* charted events of the Galactic Empire through the discipline of 'psychohistory' (Asimov, 1951). It is for the reader to judge whether this discipline was suggested as a prediction of what might be feasible in some distant future or as an ironic commentary to the effect that the necessary reduction of history to psychology is never possible.

mental states and thoughts is an issue that needs to remain central. Uttal (2009: 44-60) goes more deeply into the underlying physics of techniques such as functional magnetic resonance imaging. He, among others, also lists many of the problems of the more grandiose claims in this area (e.g. the practising neuroscientist Tallis, 2010). Uttal lists five issues (pp. 16-24): we cannot deduce thoughts from behaviour; the mind is irreducible, and does not work with separate modules for separate activities; thoughts and actions interact in complex ways; there is randomness; and descriptions of things are not explanations. Such issues do not destroy the basis of neuroscience, but they suggest considerable caution in inferring what it can deliver.

ON can be seen as a development of fields such as evolutionary psychology (EP) which aim to understand how we behave in terms of the evolution of the human brain (Nicholson and White, 2006). As one of EP's most strident critics in organization studies points out, EP is necessarily theoretically reductionist in understanding social processes in terms of psychic states. But it is also, he says, insufficiently reductionist in ontological terms (Sewell, 2004: 931). This is because EP operates in terms of 'mental modules' rather than 'individual neurones'. ON could be seen as overcoming this limitation and thus getting down to the specific way in which the brain works. It is also interested in examining the brain as it is, and not in debating how it has evolved, so that it may escape some of the problems of an evolutionary view outlined by Sewell. (Some of these problems may not in fact be pertinent, and Sewell seems to think that EP relies more heavily on theories of the evolution of the brain than in fact it does. See also for example Runciman, 1998, for a 'selectionist' view from an explicitly sociological rather than psychological point of view).

Neuroscience, Camerer et al. (2005) point out, identifies four kinds of mental functioning, and not just the one stressed in conventional economics. That one is cognitive activity which is controlled and conscious: the deliberations of 'economic man'. But in fact we can distinguish between cognitive and affective activity, and between controlled and automatic processes, thus producing four categories. An important point is that thought processes using these categories interact, so that it is not the case that the automatic and the affective are in some sense more fundamental than cognitive processes.

ON is thus significant because it claims to uncover fundamental aspects of individual human behaviour that shape how we interact. Issues such as leadership and teamwork, hitherto seen as necessarily social, can be explained in more individual terms. In a similar way, 'irrationality' is explained in terms of the ways in which human brains process information and make decisions (Ariely, 2009).

Critiques

Though ON is new, significant critiques have emerged (Lindebaum and Zundel, 2013). They mirror responses to EP such as Sewell's, and sociological critiques of such related fields as experimental economics (Piore, 2010; Streeck, 2010). A fundamental theme is reductionism: can we reduce the complex social processes within organizations to individual characteristics?

As Lindebaum and Zundel point out, reductionism has three forms. 'Constitutive' reductionism consists, in this context, in claiming that cognitive machinery constitutes all of human life, or at least all the relevant parts. Approaches of this kind can certainly be identified. They appear for example in highly successful works such as *Freakonomics* (Levitt and Dubner, 2005), which claim to explain hitherto puzzling phenomena in terms of some aspect of brain functioning, in this case the ways in which people respond to incentives. A reliance on explanations that are mono-causal as well as based on individual predispositions is a feature that sociologists are likely to find most irritating. And if strong constitutive claims

are made, there are ready arguments against them. These do not need rehearsing in detail, though two points are worth making.

The first concerns what counts as an explanation in the sense of what proportion of the variance in a phenomenon is being claimed to be explained. In careful academic reporting, results are consistent with a theory when one or both of two conditions hold. Firstly, some ‘significant’ proportion of the variance in a dependent variable is explained – significant, meaning that the results are unlikely to have occurred by chance. Secondly, results are not merely significant but also important in the sense that effect sizes are large. The danger arises when there is slippage from these senses to the implication that everything has been explained, and that we can now fully grasp a phenomenon. This slippage may not be intentional, and qualifying statements are often made. Yet, certainly when we move from academic to popular writing, the slippage is more evident. We need to be clear that some part of an explanation of a phenomenon has been found, but not necessarily a complete explanation, whatever that may be.

The second point concerns the conditions under which a result holds. If we find that ‘leaders’ have certain features in western societies, it does not follow that these features stem from the essential features of the human brain. They may do so, or the features may have some part of the explanation, but the experimental conditions under which the result arises need careful consideration. That is, ON is not claiming to have found the gene for leadership. It finds some features of mental activity, such as competitiveness or a drive for dominance, which may underlie what leaders do. But to produce leadership other things must also be present.

The Critics and Social Constructionism

The above comments would be consistent with much sociological argument about ON and cognate fields. But, as Nicholson (2005) for example comments in relation to critiques of EP, there is then often a stronger insistence that the social world cannot be reduced to the level of neurology. This is where the two other senses of reductionism come in: theoretical, wherein theories in one domain are explained by theories in another domain; and explanatory, wherein a reduced entity is explained by the reducing entity so that for example psychology is explained by how cells work. It is common here to argue that the social world is different from the physical and to stress that much of what we see in the social world is socially constituted. The division of labour in western societies is not ‘natural’, and so on.

Yet to say that something is not wholly natural or inevitable is not to say that it is wholly socially constructed. Consider Sewell’s (2004: 933-4) use of the familiar billiard ball analogy.

Although billiard balls around the world may be pretty much alike . . . when we talk about leadership we have to be very careful in defining what we mean by the term in different situations Imagine an acclaimed business leader was washed up alone on a desert island grasping a billiard ball. If he or she dropped the ball, under the influence of gravity it would still drop at a rate of 9.8 metres per second per second but this latter-day Robinson Crusoe would no longer be much of a leader . . . because every leader emerges from a particular set of historical and social conditions where others attribute to them the qualities of leadership.

There are two issues here. The first concerns the billiard ball. It will not fall as Sewell says that it will, for the statement implies acceleration with no limit. In fact, air resistance will give the ball a terminal velocity. Moreover, if the leader had landed at the top of Everest the force of gravity would be smaller than at sea level. Or on the moon gravity would be about one-sixth of that on earth. And so on. In other words, experimental conditions affect the

physical world. The fact that natural scientists can control these conditions more certainly than is the case in the social world does not mean that the conditions can be ignored or that the logic of explanation in the physical and social sciences need be different.

The second issue concerns social construction. Sewell implies that everything about leadership is socially constructed, a view in which he is far from alone. But, ON would say, there are features of human brains that generate some tendencies in some people but not others. As one EP-influenced study argues, there are clear and also large (i.e. the effect sizes are such that the differences matter) differences in the mental processes of men and women (Browne, 2006). These differences, it argues, cannot be explained by a purely social construction view, for they persist across societies and also exist in young children, that is before it is plausible to argue that they are inculcated through socialization. Runciman (1998: 164) lists a set of ‘metacultural constants’ of this kind. Now, arguing about inherent differences is controversial, especially where some relatively disadvantaged group is said to have some inherent characteristic. The argument of writers like Browne is not that the differences are necessarily desirable or that make certain things impossible. The differences are large but not overwhelming so that, in the field considered here, occupational segregation, there are relatively more men than women in some jobs but this does not mean that no women can do them. Moreover, it would be argued, awareness of inherent and specific differences can mean that they can be counteracted if this is thought desirable; by contrast, saying that all segregation is the result of some general social construction leaves policy options unspecified.

A similar point emerges from Camerer et al.’s (2005: 52) discussion of labour market discrimination. Experiments find that people respond to racial clues using automatic processing. Such results might be read as implying that racial attitudes are deeply embedded in the human brain and perhaps even ‘inevitable’. This is not, however, these authors’ reading. They explain the results in terms of statistical theories of discrimination; that is, we have least confidence in things with which we are unfamiliar. There is some evidence for this interpretation in that white Americans respond differently to recognizable black faces from faces that they do not know. Automatic responses are not necessarily fixed, and in this case familiarity, training, and so on can reduce such responses. Such an interpretation is a long way from any suggestion that neuroscience explains mental activity as the direct result of the formation of the brain during the early stages of human development.

Arguments for essential or inherent characteristics are a common target of social constructionists. Essentialism is of course to be avoided. But to say that an entity has a certain property is not to say that the property can explain everything of relevance about the entity. It is to say only that the property has causal powers of some relevance to the issue at hand.

Realism, ON and Causal Depth

It is now useful to bring in realism explicitly. It espouses a depth ontology, which might be taken to imply in the present context that inherent mental processes operate at a deeper and in some sense more fundamental level than other processes. This is not the meaning here, though it might be what those who refer to ‘primal causes’ wish to imply. I return to this theme having outlined the core of realism (drawing on the work of O’Mahoney and Vincent, forthcoming).

Realism has three core ideas: stratification, emergence, and open systems. In relation to the first it identifies three ontological levels: the ‘empirical’ of what we perceive; the ‘actual’ of events of the kind that are perceived as empirical; and the ‘real’ of the underlying mechanisms causing the events to occur. With the example of Sewell’s billiard ball, the

empirical is the observation of a ball's falling; the actual is a set of events of objects of other kinds that might fall in similar or different ways; and the real are the underlying mechanisms (such as gravity, which exerts forces on balls and feathers, and wind resistance which causes balls and feathers to fall differently). In a social setting, the empirical might be a team carrying out various tasks and procedures repetitively. The actual comprises rules and regulations, training systems, and other things that are in principle observable but that in practice might be taken for granted. The real comprises deeper processes that are posited by the social scientist but that may not be directly observable.

Forces at the deeper level influence but do not determine more concrete outcomes. This is because of two things. Those forces exert only tendencies that may be counteracted by others. And they have to be interpreted in practice. The fact that a rule exists, and that it has been followed up to now, does not mean that it can never be ignored, whether deliberately or by oversight. The ignoring of a rule may then have further results, such as further non-observance by other people and possibly its becoming a dead letter.

Emergence means that an entity has causal powers that are greater than the powers of its constituent parts. Building on the example of water given earlier, O'Mahoney and Vincent (forthcoming) argue that teams have powers and characteristics above those of individual team members. We might add that, for example, a team will generate a set of social and collective expectations as to how it expects to be treated by managers, and these expectations will have a character that exists outside what individuals would have thought without the presence of the team.

Open systems have been mentioned above. In the social world it is generally not as possible as in the physical world to achieve experimental closure. Apparently similar groups behave in different ways because they are in fact different in subtle ways and because they interpret influences on them in differing ways. Brains interact with other aspects of the world. Users of ON might wish to reflect on just what degree of closure their experiments in fact create and, indeed, to design experiments in such a way that closure conditions can be tested. This does not mean that everything they do is wholly open. Teams are teams because they have certain features in common, and the range of choice open to them is not limitless.

How, then, would realism understand neurons? They are not available to our senses and are thus not part of the empirical. They are also deeper than the actual and are among the structures and mechanisms that reside at the level of the real. This is what is probably meant by claims to have found the 'primal causes' of things. But what can such claims really mean? I mentioned above the many arguments that behaviour (the firing of a neuron) does not explain mental states. It may help to distinguish two kinds of claim.

Suppose that I want to argue, as many people would, that various aspects of organizational life reflect 'deeper' forces. For example, we might find that team work commonly fails and identify reasons at the level of the empirical and the actual such as poor communication, lack of managerial commitment, and inadequate training. But we might also want to argue that team work takes time to embed and that short-termism in capital markets interferes with the necessary mechanisms of embedding. Short-termism is here a deeper causal factor that we might locate in the actual in that it is in principle observable. It could then itself be located in real mechanisms in the operation of a capitalist economy. We have here identified some structural macro features that constrain what is possible at the level of the empirical.

But ON moves in the other direction, to find micro forces at the level of the individual brain, and in principle the neuron. These forces may well be real in the sense that have some kind of causal power, but the importance of this causal power depends on context and emergence.

The power may not be called into operation, and, if it is, its operation depends on other causal powers. When we add the fact that the brain is plastic, it follows that a causal power is not fixed; that is, one part of the brain can take on functions of other parts, so that the powers of the different parts are not fixed.

Nicholson (2005) in his defence of EP admits to having used in his popular work the inappropriate term ‘hard wired’, which could imply that a causal power is always activated and that it is never counteracted by other powers. As he now argues, there are interaction and feedback effects which make life more complex.

Consider also the meaning of the actual. I think that realists might wish to stratify further this category. If we restrict the empirical to what can be directly perceived, then something like oxygen is not empirical. It is actual in that its presence can be detected and that we know through theory and experience at least some of its causal powers. For example, the removal of oxygen extinguishes a flame. The reasons for this reside in the real, the causal mechanisms that permit combustion. We might also want to say that human knowledge develops such that we know about oxygen and neurons whereas past generations did not. They may then influence matters at the empirical level, for example a supply of oxygen for people with breathing difficulties. The popularity of neuroscience, for example the familiarity of the idea of a scan of the brain, suggests that the firing of neurons may be becoming closer to the actual. But, as social constructionists rightly argue, what is defined as actual depends on processes of social definition.

We might speculate further about this idea. If we return to the billiard ball example, a strict definition of the empirical would be the observation of its falling. But the fact that we know what ‘falling’ is, and indeed what a billiard ball is, depends on prior knowledge and experience. The brain actively interprets signals and turns them into information. We might want to say that what is categorized as ‘empirical’ or ‘actual’ depends on the task at hand. For many purposes, the falling of a billiard ball is empirical, but for some purposes, for example understanding when and how children learn the concept of falling, it would be part of the actual. We can also say that social construction is commonly involved in such categorization. The law of supply and demand, for example, is often asserted as though it is empirical when clearly it is not. The ability to make such assertions successfully depends on processes of social construction. But realism differs here from constructionism in two crucial respects. Firstly, social constructions are not arbitrary: they depend on the causal powers of some people as compared to others, and the task of social science is to grasp such powers and their related mechanisms, and not merely to reproduce the fact of a social construction. Secondly, the material world has causal powers. Things have essential characteristics that define what they are, and these characteristics have effects. Constructionism’s relentless attack on essentialism conflates the fact of essence with the error as saying that they necessarily explain anything. Emergence and context also matter.

Similar variations of categories apply between the actual and the real. Consider gravity which we now take for granted. Before Newton, it was far from taken for granted. Gravity has always been real in that it has effects without our knowing about it. But for many purposes we might take it as part of the actual, that is, the recognized processes which order the empirical. For other purposes, for example if we have a theory about gravity waves that we wish to test, what is actual and what is real is a different matter.

If we consider the exemplary case of leadership, we find Nicholson (2005: 405-6) arguing the following. Women are found in leadership positions more commonly in public services than in large private companies. This can be attributed to two things: men’s greater desire for dominance, which generates single-mindedness and competitive striving; and the moderating

effects in situations where more co-operative relationships exist and the ‘economic contingencies do not accord supremacy to the values of competitive advantage’. The structure of this argument makes a great deal of sense: there are causal powers in men’s and women’s mental make-ups that promote more or less desire for dominance; and other social forces may constrain or counteract these powers. The difficulties are at least two. Firstly, we need evidence as to what dominance really is, and that it arises from fundamental processes to do with the physical make-up of the brain. I will not enter the specific debate on this, and focus on the second issue. This is that Nicholson, like other scholars mentioned above, wants to move rather directly from dominance as a general male characteristic to complex social structures. There is no allowance for emergence or for the role of history in promoting certain arrangements. There is also no recognition that conditions that appear to be consistent with the hypothesis can have very different interpretations. It is thus assumed that ‘competitive advantage’ as promoted by dominance works best in private sector profit-seeking situations. Yet is there evidence to support this view? It might be, for example, that risk-taking promotes success but also disasters, as the banking crisis would suggest. Is it even the case, moreover, that private sector organizations are driven by a single imperative rather than by a complex of objectives? One should not, in short, over-interpret and should recognize emergence, the fact that causal powers may not be activated or that they work only in combination with others. Realism also accepts the idea of equifinality: the same result can arise from differing causal paths.

Some ON practitioners recognize such points. As Lee et al. (2012: 925) point out, the standard neuroscience method is to look at what happens in relation to some task when a region of the brain is activated. But, firstly, activation here does not necessarily mean that other parts of the brain are not involved. Secondly, the amount of activity in a region does not measure the importance of the region in performing the task. In other words, causal powers may be exerted in ways that an experiment does not test, reflecting in part the point about open systems: given the complexity and interconnectedness of the brain, achieving experimental closure may not be possible. Moreover, what is causally important in a task is not the same as the measured amount of mental activity.

Yet, writing elsewhere, these authors also develop arguments that seem less sensitive to causal complexity and the importance of context. Noting that the cortical networks involved in receiving pay are the same as those involved in consuming pleasurable items such as chocolate, they argue that the relevant networks can predict subsequent activity in the brain regions that drive performance, thus ‘explaining how the motivational effect workers receive when they get paid drives them to complete a particular task’ (Senior et al., 2011: 808). If we want to know why workers are motivated to carry out certain tasks, we clearly need to understand many things about the organizational and social context. Knowing that rewards can stimulate mental processes is only one part of the story. Do rewards always work in the same way for one person, do they work similarly for different people, do their effects decay over time, is their operation affected by other factors, and so on?

Some of the core propositions of ON and EP may thus be defensible, and when the ideas are presented with care they have several strengths. Yet they easily lend themselves to over-interpretation, especially where scholars wish to find a simple and unique truth.

Conclusions

Emergence and social norms are occasionally recognized in debates on experiments. Levitt and Dubner (2009: 120, 122) discuss field experiments. Some classic experiments put people in a position where altruism is more or less the expected response, they argue. A standard case is a game in which one player is given a sum of money and told that she can share as

much or as little as she pleases with the other player; a pure economic maximizer would share nothing, but in many experiments in many contexts sharing takes place. Some people might then conclude that altruism is hard wired. As these authors point out, experiments that vary the conditions generate different results.

If your only option in the lab is to give away some money, you probably will. But in the real world, that is rarely your only option. . . . Human behavior is influenced by a dazzlingly complex set of incentives, social norms, framing references, and the lessons gleaned from past experience – in a word, context.

Indeed. The solution, therefore, is not to look further into the brain for the ‘fundamentals’ of behaviour, but to acknowledge emergence and context and to consider how mental processes interact with ‘context’ to produce social behaviour.

I have elsewhere written of field experiments in economics, arguing that their approach can in principle be combined with that of a social science that is sensitive to emergent properties, equifinality and the like (Edwards, 2012). But I also noted an absence of active efforts by experimentalists to learn from other social sciences, which mirrors the disagreements of many people within those sciences about ON. Such divisions are indeed social constructions, and it is conceivable that the development of new experimental methods will suggest that both sides need to reconsider their positions. Whether that happens remains to be seen, but given the resilience of paradigms in the social sciences I think it unlikely unless there is some undeniable breakthrough or some other event that leads to paradigm shift.

That said, ON seems likely to continue to develop, and if it is merely attacked it will not take cognisance of the significant qualifications to be entered from social science. There remains the possibility of shaping its development by asking about the causal powers of mental processes, the conditions under which they are activated and the nature of their effects. Realism provides a way of doing so by suggesting explicit attention to the question of closure conditions in experiments. It also helps to refine the grounds for disagreements about ON. The idea of essential properties of brains can be accepted, but the themes of context, open systems and emergence point to the limitations of the ON project.

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