Two Views of Decision Making

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(Received 2015.1.5)

This paper starts from the notion that there are two approaches to the description of phenomena: a western, scientific approach which dichotomies, and a eastern, humanistic approach which is integrative and dialectical. In the western form, the highest form of logic depends on the law of the excluded middle, and opposing pairs of concepts are created: mind/brain, spirit/body and so on. In contrast with that, eastern logic emphasizes the unity of opposites and balance in a holistic worldview.

The paper then goes on to look at one area of western science, the neuroscience of decision making, and shows how destructive it is to understanding the majority of decisions to attempt to lift decisions, or release decisions from their context in this analytic way.

The paper concludes that western science might benefit from a careful study of eastern approaches to unity, which might actually fit more comfortably with the notions of complexity that western science is now struggling to comprehend. Above all, the analytical approach focuses on the short term and the context free, which means that it has little to say about education or the concerns of educators and educationists.

Key words: neuroscience, decision-making, holistic approaches, time-scales

Introduction

This paper is about decision making. It is also about something else, however. It is about the contrasting styles of thinking about things; the western European approach is analytic, while the Japanese approach is synthetic, integrative or dialectic. Western modes of thinking involve a process of breaking down, of dichotomizing and of noting sharp distinctions. Asian ways of thinking involve more balance, and a recognition that two opposites make up a whole. Although I, as a European, may talk about having a “gut feeling”, or of combining head and heart (to signify the balance of reason and emotion), nevertheless my idea of thinking is cerebral. Although the heart is the metaphorical seat of emotion, I know that really emotions involve the firing of neurons in the brain.

As I understand the issue, Japanese scholars do not suppose that thinking is localized in the brain. One does think differently when physically fatigued, while a hearty meal and a cup or two of alcohol can entirely change one’s perspective on an issue. This is a recognition of the idea that one thinks with one’s whole body, and maybe even more than one’s body, and not merely with one’s brain.

A similar contrast may perhaps be found in the way that we think of writing. I rarely write (as opposed to typing) nowadays, but when people did write with pen and ink it was not unusual to speak of a person’s “hand”, meaning their handwriting. Europeans write with their hands. In contrast, Japanese people and Chinese people write with their whole bodies. Advanced learners of writing will sometimes use a brush which is five or six feet tall to paint the Chinese characters or kanji. This is a quite common exercise, designed to make the writer more aware of the bodily movements that are necessary for the process of writing. Putting aside that giant pen and taking up the normal one, the writer remains conscious of those movements, so that the fluid brush strokes derive not only from the movements of

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the hand, but from an awareness of the whole body. At least, that is the theory, although I cannot claim that I have any direct experience of the sensations. A westerner might think in that way about golf, but is unlikely to think about writing in a similar way.

This is not a case of synecdoche on the part of Europeans, where they metaphorically speak of the part as representing the whole; Europeans speak as though the parts of the body could function in isolation. Japanese scholars have devoted a good deal of effort to trying to understand this analytical turn of mind. European scholarship might benefit a good deal from a complementary effort to understand Japanese integrative approaches. However, that effort will have to wait for the future, as I am not in a position to offer such an analysis now.

Instead, this paper will look at an extreme example of European, analytical thinking, the neurological study of decision making, and show how the analytic approach is destructive of any sensible understanding of everyday processes. The implications for our understanding of education will also be examined.

Readiness Potential

In the 1980s scientists developed the technologies, the precursors of modern fMRI brain scans and electroencephalography, which made it possible to investigate the activity of the living brain. Among the pioneers, Benjamin Libet (1985, 1993) measured brain activity, using electrodes on the scalp of the subject, associated with the decision to make a physical movement. Before the subject makes a physical movement, it was well established that there was a build up of electrical activity in areas of the brain associated with motor control. This was typically measured through the "readiness potential", an electrical potential which precedes any specific movement (Libet et al., 1983).

Subjects were asked to make a voluntary movement, move their hand, raise their arm or press a button, at a time of their own choosing, while the activity of their brain was being monitored. A clear sequence was established that the readiness potential was observed before the movement. In addition, if the subjects were asked to choose which hand they moved, the readiness potential would be greater in the side of the brain that controlled the movement (the right side of the brain controlling movement of the left hand, and the left side of the brain controlling the right hand). This is known as the "lateralized readiness potential".

Libet's innovation in such studies was to try to place the subject's consciousness of having made a decision on the timeline leading up to the movement. He did this by asking subjects to watch a clock, a rapidly rotating pointer, and to remember what the position of the pointer was at the instant when they were aware of having decided to move. The results were quite striking; the subject was consciously aware of having made a decision to move before moving, but after the beginning of the rise in the readiness potential. That is to say, a scientific observer of the subject's brain activity would be able to predict that the subject was about to move when the readiness potential rose, typically about half a second before the subject actually moved. However, the subject would report being conscious of having made a decision only approximately a quarter of a second before moving.

Libet's conclusion was that a causal chain of events, starting with the readiness potential and ending in physical movement, began before the subject was conscious of having made a decision to move, and that, therefore, a conscious decision could not be the cause of the movement. This led Libet to the conclusion that the sensation that we choose is a psychological epiphenomenon which is irrelevant for the actual effective choices that we make, which are unconscious. The implications of this for our concept of free will are, of course, profound. In its popularized version, we do not make decisions at all, but our perception of free will is actually a cosmetic façade on decisions that are driven by our biology (Haggard, 2011).

Subsequent studies have cast some doubt on Libet's methods, especially in relation to the use of a person's memory of the position of a clock hand to record the time of a conscious awareness. After all, that process itself involves a conscious decision to remember something, and if the timing of conscious awareness is the matter under review, the errors in when event happened are likely to be of the same order of magnitude as the times that are the topic of the main measurement. Experimental methods have refined Libet's original approach, and it has been shown, for example, that the time when a decision is perceived to have been made can be influenced by whether that decision was effective in producing the desired result (Lau et al., 2004). But these difficulties which have been investigated through modifications to the original method have been paralleled by improvements in the technology of brainscans, and some studies have claimed that it is possible to predict a decision to move as much as ten seconds before the actual movement occurs. It seems to be inescapable, therefore, that some brain activity related to a decision occurs before the subject is aware of having made a decision (Soon et al., 2008).

In the light of my early points about analytic, western approaches, and synthetic eastern approaches, it is perhaps worth emphasizing that these experiments are firmly in the former tradition. Libet's experiments, and all subsequent variations, presuppose that, from all the continuous stream of brain activity that proceeds throughout a person's life, it is possible to isolate that one element of brain activity that is associated with making a decision. Similarly, from all that stream of consciousness of which we are aware every waking moment, it is possible to pick out and isolate a single incident which can be called "making a decision". And lastly, the experiments rely on the notion that we can compare the timing of those two events, and conclude that one comes before the other. In the circumstance, as seems likely, that the identified brain activity precedes the conscious awareness, we are left with a conundrum about free will. Before proceeding any further, it seems sensible to examine how much of this problem arises from the analytical bent that lies at the heart of western science.

Decision Making

In order to identify a correspondence between a moment of decision and brain activity, the first thing that must be done is to identify a moment of decision. Typically, this is achieved experimentally by giving the subject of the experiment a task and asking them to decide when to do it: "I would like you to raise your hand at a time of your own choosing, say within the next five minutes". We certainly make some decisions that are like this, but in a way they are an exceptional kind of decision.

The alarm has gone off, and I know that I have to get up and go to work, but I think that I will delay it for a few minutes. I would really like to have a cup of tea, but I do not want to go to the kitchen to make it until the television programme I am watching has finished. But decisions where we know what we are going to do, and the only issue is when we are going to do it are not the most important decisions that we make. And they never come completely isolated from context, as in the laboratory example. There are other issues at play that will affect my decision, such as the uncertainty of transport, the temper of my supervisor and whether the television programme is likely to be repeated in the near future. Knowing what it is that I am going to do in the next five minutes and being completely free to make that decontextualized decision is rather rare.

Real life decisions are almost invariably more complex, and, most importantly, not located at a specific point in time. Consider the example that I have used to illustrate this point on some occasions at conferences. I ask the members of the audience, the participants in the experiment, to raise their hand if the result of a given mental arithmetic exercise is 68 (which is, in fact, the correct answer). There is a pause before anybody responds, and then, after that pause, participants begin to raise their hands. But at what point did they "decide" to raise their hands?

They presumably made some kind of conditional decision to raise their hands, if and only if the answer was 68. When they had calculated that the answer was 68, they presumably made a provisional decision to raise their hand. At that point they may have looked around the room to check whether anybody else had raised their hand, and, by implication, check that they were not going to look foolish if the answer was actually 70. The decision, therefore, looks less like a point in time, and more like a process smeared across time, at the very least across the time from when the task is set to the time when it is concluded. There may even be those who cannot be bothered to perform the sums, but who make a different, social calculation when they see the majority of the group raise their hands.

There is no need to limit the smearing of the decision making to what happens in the room. Presumably those participants had all made a decision to attend a particular session of the conference, and had decided, or took it for granted, that if they were asked to take part in such an exercise, they would comply. Or perhaps, when they were ten years old their parents taught them that they ought to be polite to strangers, even strangers who made odd requests, so long as they did not represent a threat to their physical well-being. Real life decisions depend on a range of aspects of context, and it can often be very difficult to see exactly what should count as making a decision.

To take another example, some months ago my wife and I decided to buy a car. Three years ago, my wife and I had bought a car that was two or three years old, and we had congratulated ourselves that we had bought a car that was in many ways as good as a new car, but at a much lower price. We had often mentioned this in conversation, so we had implicitly decided that the next time that we bought a car we would by a nearly new car. One day I received a letter from the car agency inviting me to an "open day" to see their new models. We really had no immediate intention of replacing our car, but we thought that it was worth going to check; when buying a nearly new car one's choice is obviously limited to those nearly new cars that owners have decided to sell, so it is best to be a little flexible. In addition, some minor incidents with the car we owned had led me to have a little less confidence in it. So there were a constellation of factors in place which disposed me to consider the idea of looking at changing car.

On the day, although we had no specific intention to buy a car, we did see a car we very much liked, and decided to buy it. I suppose in one sense this is analogous to the experiments performed by Libet and his successors: "You know that you are going to buy a car at some time in the next two years. Choose to buy a car at the time of your choosing". Certainly, my wife and I were at some point sitting in the showroom facing the decision as to whether we should or should not buy this specific car. But long before then we had made decisions that contributed to that decision. We could not have had the choice to buy the car had we not first decided to spend an hour or two at the showroom. We were performing complicated calculations as to the likelihood of expensive servicing costs to the old car should we decide not to buy the new car. If the annual cost of running a car is made up of three components, annual depreciation, servicing costs and peace of mind, when the costs of Car A exceed those of Car B, sell Car A and buy Car B. Even this relatively simplified calculation makes the laboratory experiment on decision making look simplistic, and it by no means represents the full complexity of a real decision.

Educational decisions, which is to say decisions that are important to the process of education, are similarly spread out over time. Decisions such as choosing which school to attend, which subjects to take, or even something as simple as paying attention in a specific task, involve long chains of events. When did I decide to be an engineer? At some point I looked at the range of options that were available to a student who had studied mathematics and physics. But before that I had chosen to study mathematics and physics, and that choice was based on what I enjoyed, what I was good at, what I found intellectually satisfying, and what I got good marks in. and, of course, I was good at it because I enjoyed it, and therefore devoted more time to it. And I enjoyed it because I was good at it and was praised for doing well. And so a cycle of not-really-deciding-but-going-in-a-selected-direction extended over years.

Where would I put the beginning? Well, too far back to be certain that there ever was a beginning. Long before I got to secondary school, I found some books on the bookshelves at home titled "Living things for lively youngsters" and "Moving things for lively youngsters". I preferred the latter over the former, and hence the preference for physics over biology. Or perhaps it was the nascent interest in physics that made the latter more attractive. Who can tell?

When did I decide not to be an engineer? It is hard to tell. It slowly crept up on me that the engineers who taught me were interested in things that I did not find particularly intellectually stimulating. They were pragmatic in their concern about whether things worked, and seemed not to be interested in the theory they employed. And then there was my contrary attitude, that I did not think I wanted to be told what I could work on, at the same time that I did not understand how one could be a civil engineer without being a small cog in a very large firm. And so, some time between the summer of 1971 and the summer of 1972 I made a decision, but I could not narrow it down any further than that.

In the stream of life experiences that make up an education, teachers, educators, educationists and students are concerned with those that take time to mature. Certainly there are moments of sudden insight that one can pinpoint to a particular place and time, but they are rare in comparison with those that are a slow burn. So the question clearly arises as to why it should be that the sudden decontextualized decisions are the ones that are taken as typical by the neuroscientists. And we must suspect that it has something to do with the dissecting, analytical conceptual framework that is at the heart of so much western thought. I shall return to this point in the context of the other side of the analysis, the identification of neural activity, but one is left with the speculation that discrete, isolated decisions are the subject of scientific study because they are the only ones that are susceptible to the scientific methods available.

Neural Activity

The present technology has certain drawbacks when looking at neuronal activity. The methods adopted by Libet, of measuring electrical activity using electrodes on the scalp, can produce results that are specifically located in time. Electrical responses are immediate, but are very difficult to locate in a particular region of the brain. Scalp measurements are obviously less invasive, and therefore less risky, than implanting electrodes inside the brain, but they carry the disadvantage that they represent an average of brain activity over a quite large area – actually a huge area in relation to the density of neurons in the brain.

Such electrical approaches have lost ground, particularly in the popular imagination, with the advent of functional magnetic resonance imaging or FMRI, which can produce such graphic pictures of the brain, showing which parts are active. The drawback is that the raw data that these images are constructed on are measurements of the flow of oxygenated blood, and blood flow can lag behind electrical activity by as much as two seconds. In addition, since blood vessels can supply many neurons, this approach also produces average values across many brain cells, although the changes are much more precisely located in the brain than is the case for electrical measurements. So electrical measurements are precise in terms of time, and blood flow measurements are more precise in terms of space, but neither method is ideal. There is some promise that a combination of these and other methods may be able to produce measurements that are precise in terms of both space and time, but that may be some way off yet.

Moreover, as Roskies (2008) points out, brain scan images can be misleading to the extent that they suggest that brain activity is localized in specific areas when specific mental functions are performed. The fact is, however, that all of the brain is active at all times. What brain scans actually show is that, during specific mental functions, averaging across a large number of subjects and a larger number of events, there is an increased probability of slightly increased activity in certain regions of the brain. That means, of course, that looking for brain activity associated with a specific mental function, such as making a decision, is literally like looking for a needle in a haystack, or perhaps more like looking for a piece of hay in a haystack, because the brain activity that is sought is hidden among a great deal of similar brain activity.

The practical upshot of this is that the empirical search for connections between brain activity and mental activity relies upon definitions of mental functions that are short-term. If we were to admit that a decision making process might be extended in time over many minutes, never mind days or months, it would be a hopeless task to try to look for the brain activity associated with it. How could one possibly know that a particular piece of brain activity five minutes before, or after, consciousness of making a decision was actually associated with that decision?

Brain activity, such as the level of flows of oxygenated blood, is influenced by many other factors, besides the level or type of mental activity that is going on. Time of day, level of activity, emotional responses and hunger and tiredness (or their absence) can all affect the flow of blood through the brain. These background changes, which the neuroscientist regards as background noise, would completely swamp any changes that occurred as a result of specific brain activity, if that brain activity was conceptualized as taking place over longer periods.

In fact, the software that is used to analyze the data from fMRI scans typically screens out any fluctuations with a period of more than a few seconds (MRC Cognition and Brain Sciences Unit, 2009). In practice, the focus of attention of the neuroscientist can never be more than a few seconds. The typical fMRI study, therefore, relies on a "boxcar" design, contrasting two mental states in fairly rapid succession. A subject might be asked to think of their favourite painting for a second or two, and then think of landfill site for a second or two and then the painting again. Differences in brain activity between the two states might then be taken to indicate the parts of the brain that relate to judging beauty, or motivate recycling. Although the results of neuroscientific investigation may be fascinating and suggestive, they can never address the issues that are of concern to the educator, which, as noted above, typically relate to processes that have an extension over time of weeks, or even years.

Dealing with Complexity

What should be clear form this discussion is that both the stream of consciousness, the flow of our thoughts, and the stream of brain activity, are extremely complex. The idea that one item in each stream can be selected out for study, and that the one that comes earlier in time can then be judged to have caused the other, appears, on reflection, to be extremely naïve.

I want to emphasize the significance of the term "complex" in this context. Complexity is a technical terms and it describes systems that have particular features. It is not merely a matter of those systems being complicated. To be complex, they must demonstrate non-linear responses. That is to say, very small changes in the initial state of complex systems can produce very large changes in the outcomes. This is the famous "butterfly effect", that a flap of a butterfly wing in the Amazon Basin can trigger a tornado in Texas (Turner, 2004).

It is tempting, to the western observer at least, to see this in analytic terms. There is a cause of the tornado in Texas, and with improvements in technology we will eventually be able to refine our research methods to the point where we can identify the individual butterfly that causes the tornado. But in the case of complex systems, this dissecting approach is misguided. It is not simply the case that the cause of the tornado is so small that we have not yet been able to identify it. The point is that the cause of the tornado is so small that it is, in principle, incapable of being known. Suppose that we set off to catch the butterflies to identify their motions. All that swishing of butterfly nets will trigger as many tornados as the butterflies did in the first place. Or, if investigating butterflies with butterfly nets is too crude, we might set up infra-red detectors throughout the Amazon rain forest. But we cannot suppose that the activity of those sensors, however slight, might not have some effect on air flows, and consequently on meteorology thousands of miles away.

Because such causes are essentially unknowable, it can often seem that complex systems are capable of picking out the causes that will influence them. Such are the causes that interest educators. The same lesson can be taught, or presented, to thirty children, but it will have a lasting effect on only two or three, and be remembered as a life-changing moment by at most one.

The stream of consciousness and the stream of brain activity proceed in parallel, and may well be causally connected. But if they are causally connected, it is the causation of the butterfly effect, and we will never be able to detect it. Rather we should be thinking about a different kind of causation, where the whole of one's physical and mental activity function as a single complex system, and where it is barely possible to separate mental functions from their physical correlates.

It is hard for me, trained as I have been in the ways of western science, to even imagine what such an understanding would look like. Perhaps it would be easier, or at least more imaginable, for a scholar from the east, who has been brought up with integrative instincts, and a commitment to balance. And this brings me back to a comment that I started this paper with, that it would perhaps have been wise if occidental scholars had devoted as much effort to understanding the concepts of integration as oriental scholars have devoted to understanding dissection. Perhaps now, as the neuroscientists and cognitive psychologists lead us off down yet another blind alley of analysis, is the moment.

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