Mind, Pattern and Information

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I Introduction
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Whenever we start to think about the problem of "What is the mind?", we are struck by the notion that some degree of _abstraction_ is necessary. Adding or subtracting a neuron here and there makes no essential difference to the mind. What is important to the mind is the overall _structure_ of the brain.

Whenever we abstract, we abstract out a · _pattern_. From a given substrate, many different patterns can be abstracted; and it is possible to abstract the same pattern from many different substrates. Inseparable from the concept of pattern · is that of _information_. Every pattern carries information, and all information is carried by a pattern.

It is the central thesis of this paper that _mind is pattern_, abstracted from the substrate of the brain. A mental event is just a pattern present somewhere in the brain at a given moment. Or, equivalently, a mental event is just the information contained in that pattern. This notion of double aspect, as both pattern and information, is very useful. The view of mind as pattern explains the third-person view of mental events; the view of mind as information explains the first-person view of mental events.

From the third-person viewpoint, the view of mind as pattern is nothing unusual. When a psychologist or a neurophysiologist speaks of a mental event occurring in the brain, they do not specify the location or behaviour of ,every last neuron. It is the overall configuration that counts. The way the neurons relate to each other and fit together into a pattern is far more important than trivial details on the lowest level. The task of the neurophysiologist is to determine how neurons go together to make up the patterns; the task of the psychologist is to determine how these patterns behave, considered in their own right.

It is in the first person that this view is interesting. I _am_ a pattern (the question "Exactly which pattern?" is the domain of the neurophysiologist). A given mental event is a pattern within the pattern which is _I_ (alternatively, information within the information which is I). The unique nature of mental experience and perception comes about because this is the only pattern which I have _identity_ with; all other patterns I can only perceive, indirectly.

This immediately implies some form of Platonism. From the third-person viewpoint, the view of mind as pattern need only be a convenient shorthand - an abstraction which we take because it makes it easier to organize our conception of what is going on. But from the first-person

viewpoint, we know that minds _exist_, in some absolute sense. So if minds are patterns, then there is a sense in which these patterns can be said to exist, prior to our perception of them (unless one wants to take the somewhat circular line that a pattern's perception of itself brings itself into existence!). If this is true for abstract objects such as minds, then there seems to be no reason why it should not also be true for other abstract entities such as mathematical objects. But we are getting ahead of ourselves.

II Pattern and Information
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The concept of "pattern" seems to be one of the fundamental primitives of philosophy. There seems to be no way to define the term except in terms of equally high level concepts such as "structure", "abstraction", "form", "information" and so on. Nevertheless it is a term which we know how to use. One is tempted by Hegel's definition of "abstraction" as "replacement of the whole by the part"; so "pattern" is something like "the isolation of certain parts of the whole and their relationship". But this is really only so much waffle.

The fact is, we use patterns and abstractions all the time, in speech and in thought. Even a concept like 'table' is an abstraction, in two distinct senses. Firstly, an individual table is an abstraction from a molecular substrate - from the 'point of view' of individual atoms, there is nothing which immediately distinguishes the table from the rest of the world. We might call this a _local abstraction_. Secondly, the general concept of 'table' is an abstraction from individual tables all over the world of certain common features. We might call this a _global abstraction_. An important example of a global abstraction is a mathematical concept such as a number. This paper will be concerned mainly with local abstractions.

I regard "pattern" and "abstraction" as equivalent terms. The word "abstraction" mainly serves to emphasize that a pattern is to be regarded as an entity in its own right, independent of the substrate in which it is embedded. We always 'jump a level' when we consider a pattern.

An example: consider three objects. (1) a circle drawn in chalk on the ground. (2) a circle drawn in pen on paper; (3) a long-playing record. In terms of their physical substance, these are three very different objects. But each carries a local abstraction of 'circle'. This is the _same_ pattern in each instance; more precisely, the patterns are _isomorphic_. Later we will see that two patterns are isomorphic if they carry the same information. If a substrate carries a given pattern we call it an _instantiation_ of the pattern. (If you like, instantiation is a left-inverse of abstraction.)

The notion of 'information' is about as undefinable as that of 'pattern'. In the mathematical sense of the term, information is arbitrariness; a choice of one way for things to be out of a number of possibilities. But this already assumes some degree of abstraction - how do we decide which are the possibilities, what is the framework in the first place? Information is quite inseparable from pattern. Whenever we have

information in the world, there must be some structure carrying it, some pattern. Conversely, we can think of every pattern as carrying information.

Another example: consider (1) our record again, this time specified as a recording of Beethoven's Ninth Symphony (2) a musical score of Beethoven's Ninth Symphony. Within each of these objects there is a pattern which represents the same thing, the music of Beethoven's Ninth. The symphony is the information carried by the pattern. The two patterns here are isomorphic - they carry the same information. We can say that the symphony is the information, or even is the pattern. Essentially a pattern and the corresponding information are the same thing - they are just two different ways of looking at it. This will be of great help when trying to reconcile the first-person and third-person views of the mind. If you wanted to sound mystical: information is pattern from the inside.

The example of the record shows another thing: it is possible to abstract many patterns from the same substrate. We can cut up reality in many different ways. It all depends on how we wield the knife.

III Mind as Pattern and Information
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Any creature or system that is capable of intelligent behaviour must possess great internal complexity. Its internal structure must be able to represent countless different perceptions, thoughts and memories. Each perception (for instance) will be represented by a structure which corresponds to the object perceived. In the physical structure there will be much irrelevant 'information'; but there will be an abstraction which corresponds exactly to the perception (after all, a perception contains information, and information must come from some pattern). I say this pattern is the perception. This is quite reasonable and uncontroversial from a third-person viewpoint (after all, from a third-person viewpoint we can say whatever we like, whatever is convenient). But from the first-person viewpoint also, I say the perception (image, sound, sensation, whatever) is just the pattern. Or, to sound more intuitively reasonable, the perception is just the information carried by the pattern.

Take the example of a visual image. What happens when we perceive an object visually? Light strikes the object, and photons reflect towards the eye. In this stream of photons is carried certain information about the object: its shape in a two-dimensional cross-section, the wavelengths of light that various parts of it transmit, and so on. The photons strike the retina, producing an new instantiation of the information (an instantiation which is superficially quite similar to the original instantiation). Then electrical impulses carrying the information travel up the optic nerve, although the instantiation is now in a superficially very different form. The impulses reach the visual cortex. Now the information is present in a complex structure of neurons and neural impulses.

I say that this pattern is the visual image. Dennett [2] points out that from the third-person viewpoint, mental images as such are not really necessary - all we need is a belief that we have these images. But from the first-person viewpoint, it certainly seems evident (believe me!) that

such images exist. While first-person claims are not necessarily incorrigible, it would seem strange if we were mistaken about something as fundamental as this. From the first-person viewpoint, I identify the visual image with the information which the pattern carries. It seems indisputable that a visual image (if it exists!) contains certain information; I say that it is this information.

This information is, very roughly, information about the wavelength and intensity of light transmitted by various parts of the visual field, which translates into information about the shape of objects and their colours (it does not matter for our purposes whether or not this 'information correponds correctly to the outside world). Colour is a good example. Our sensation of colour is simply the information that light of a certain wavelength is transmitted. It is obvious from a third-person viewpoint that such information is present in the brain – functionally, this information makes a difference. From the third person, we can regard colour sensation as that particular pattern in the brain which carries the information. (This is roughly equivalent to identifying it with the functional role that the sensation plays – a comparison with functionalism will be made lately). And from the first-person, colour sensation is the information. This is a good example of those peculiarly first-person phenomena, qualia. The general rule is: Qualia are just information.

Or take depth vision. When we look with one eye, we do not receive so much information about the relative distance of objects; so the visual image is relatively flat. With binocular vision, much more information is available; the visual image consists of more information and so is much richer, much deeper. The pattern itself is of course correspondingly more complex and richer.

Another example: after-images and imagined visual images. In both cases there are patterns in the brain which carry certain information. This information has been stored somewhere in the brain; perhaps in a non-conscious centre. When this information is recalled to a conscious centre, a lot of the original information has probably been lost, but some remains. This information is our image. This is why the image seems fuzzy and not so 'real' – there is far less information. Occasionally, if the imagination has been working overtime, a large amount of information is available. This gives much more of a feeling of reality – perhaps a hallucination.

Similar analyses can be given for the whole range of first-person mental phenomena: non-visual perception, thoughts, pains and so on. In all cases, the idea is the same. From the third person, these can be regarded as patterns in the brain; from the first-person, they are just information. We might say first-person mental events are the direct experience of information.

So in the brain there are many patterns which constitute mental phenomena. Put together, these patterns form one large pattern. This is the mind. Alternatively, the mind is the sum of the information of each mental state. There can be a difference here between the first-person and third-person conceptions of mind. There are many patterns present in the brain which do not correspond to first-person mental states. Only a small subset are actually experienced at a given time. Nevertheless many of the

others can be regarded from the third-person viewpoint as mental states.
Examples include many memories, beliefs, desires, as well as the entire
gamut of 'subconscious thought.' These patterns certainly play a role in
the functioning of the mind; but the first-person concept of mind is only a
certain pattern in the brain.

IV Brain As Pattern Processor
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     First-person concepts such as 'the mind' and 'consciousness' have
always seemed like weird and wonderful things, almost mystical, which
require great philosophical leaps to understand. Contrasting with this, the
third-person viewpoint is almost mundane; it merely poses great technical
difficulties in understanding the structural and functional mechanisms of a
complex system obeying the laws of physics. So it is interesting to note
that the fact that we talk about having 'minds', and the way we describe
'mental events', are in principle third-person-explainable phenomena. A
study of the brain should be able to explain these facts without getting
metaphysical at all. Any theory of mind had better be able to match up
this 'mind' that the brain perceives with what the theory says the mind
'really is.' OK, so maybe my mind really is some silly thing like a pattern
- but then why does my brain talk about it?

     To answer this question, we develop the idea of the brain as a 'pattern
processor.' This is merely a third-person, functional viewpoint - it says
nothing about what is 'really going on back there.' But hopefully the ideas
should match up.

     When we think about the brain, we are struck by the fact that it does
not perceive itself on the lowest level. We only know that the brain is
made out of such things as neurons through third-person observation, not
through introspection. When the brain perceives itself, it perceives itself
holistically - as a higher-order structure, as a pattern.

     We weill, regard the brain here as part pattern processor and part
central processing unit (CPU). This is a functional description which need
not necessarily bear close resemblance to the superficial structure of the
brain. Essentially, the CPU corresponds to the 'conscious' part of the
brain - the part which does the processing that we notice, in areas such as
thought, speech, perception and so on. The CPU only deals with high-level
concepts. The 'dirty work', which is probably the vast majority, is done by
the pattern processor. This has the task of performing the conversions
from low-level to high-level and vice versa. The workings of this part are
totally hidden from the CPU. It can be regarded as concretely performing
the tasks of abstraction and instantiation.

     Consider speech, for instance. The CPU decides to say a certain word,
and it issues a high-order directive to the pattern processor. The pattern
processor has to break down this directive into a concrete instantiation,
and perform a complex sequence of mouth movements and air expiry, via
complex signals around the brain. Or consider directional auditory
perception. Information enters the brain through both ears, and gets coded
into a very complex structure in the auditory region of the brain. Somehow

coded in this structure is information about which direction the sound came from. The pattern processor must extract this information and send it to the CPU as a symbol, pure information, pure pattern. In fact the pattern processor is very versatile, as can be seen by experiments such as those involving lenses that distort visual perception. In the end, it extracts the relevant information regardless of the superficial form. (Of course I do not claim that there are actual parts of the brain corresponding to the CPU and the pattern processor. I merely claim that this is a valid way to look at the brain functionally.)

All the CPU ever sees are the high-order constructs - the patterns. After all, if it had to keep track of every individual neuron it would have quite a difficult (not to say paradoxical) task. If it is to have any self-perception, this is the only feasible way. But to the CPU itself, this seems quite mysteriously. "What are these strange objects that I deal with all the time, I can't see how to explain them?" "What is this _feeling_ I have that that sound came from over there?" As the low level is quite invisible to it, the CPU invents talk of mysterious 'mental events.' The CPU perceives even itself on a high-level, as a CPU and not as a collection of neurons.

So we see the brain can only perceive itself as pattern, as information. So it perceives itself as a _mind_. This fits our theory very nicely. The mind _is_ just those patterns which the brain perceives. Simply laid out:
     (1) The brain perceives itself as pattern.
     (2) The mind is pattern.
∴ (3) The brain perceives itself as the mind.
Or to put it from a first-person viewpoint, identifying myself with the structure of the CPU: I perceive everything as pattern; I am pattern; so I perceive myself _as_ myself.

In a way, this is quite 'lucky' for me. After all, I might have _been_ any old pattern. I am fortunate enough to be a pattern in a system which has powers of pattern perception; so I am able to perceive myself and talk about myself. Who knows how many patterns are out there, unaware of their own existence! It is the fact that I am a pattern in such a pattern-processing system that makes me _conscious_.

V Some Questions And Answers
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Here are some of the old chestnuts of the mind-body problem. Let's see how this theory copes with them.

(1) Why are mental events seemingly private?

This is because the pattern that constitutes the mind is the only pattern with which we have _identity_. All other patterns we can merely _perceive_. This fundamental asymmetry creates what Gunderson [4] calls the investigational asymmetry of first-person and third-person claims.

(2) Why are mental events seemingly non-locatable?

This is because abstractions are not physical objects in space. In a sense, they exist one level up. The substrate from which a pattern is abstracted may have a location, but the pattern itself does not. This and the last question are examples of a general phenomenon: the properties of the abstraction can be quite different to the properties of the substrate.

(3) Why does the mind seemingly play a causal role?

Because the pattern itself does play a causal role. The pattern at time t helps determine the state at time t+Δt. Standing alone, one might regard the first-person experience as epiphenomenal; but we have identified the first-person and the third-person phenomena.

To be sure, the pattern does not tell the whole story. Whenever we abstract, we lose some information. Low-level phenomena can still make a difference; this is why often we have no idea what our action will be until we do it. The fact that some information is lost is why the 'laws' of 'folk psychology' are very rough and inexact. We cannot expect an abstraction to behave deterministically.

Furthermore, there are many patterns in the brain which are not first-person mental states. These might correspond to 'subconscious thought' or other convenient abstractions such as beliefs, desires, personality characteristics and so on. These patterns are deserving of the word 'mental' only insofar as they causally affect first-person mental states.

(4) Could robots or computers be conscious?

Emphatically yes. In principle it is quite possible that an artificial machine could have internal patterns just as rich and complex as our own. Indeed, any system which is capable of intelligent and flexible behaviour must possess an internal system of great complexity, with patterns representing perceptions and thoughts. And from a third-person viewpoint, it must have some kind of self-scanning mechanism - a pattern processor. So just as in the human case, we can identify first-person mental states of the system with certain patterns. Such a system would be just as conscious as you or me. A pattern itself doesn't care what the substrate is made of.

(5) What is going on in Searle's 'Chinese Room?'

Searle [6] postulates the simulation of the internal workings of a conscious being thinking in Chinese by a monolingual English speaker manipulating slips of paper and following formal rules. The simple answer to this is that such a system must be immensely complex and possess many sub-patterns corresponding to various mental events. Such a system would be just as conscious as the being it is "simulating." Even if the entire system is internalised by the manipulator, the patterns are still present. Of course the patterns are quite different to those which constitute the mental states of the English speaker. There is no reason why the English speaker should have any first-person mental states in common with the Chinese speaker. In effect, there are two separate conscious beings abstracted from the same substrate. We must always remember that there are many patterns present in a given substrate - it all depends on how we wield the knife.

VI Relationship With Existing Theories
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One of the nicest features of this view of the mind is that it has much in common with many existing views. In some ways, it shows why each of these views are plausible, and that when looked at in the right way they are not necessarily contradictory.

(1) Identity Theory

At first glance, the view of mind as pattern does not bear much relation to the view of mind as a physical object. One view is abstract, the other concrete. But when we look at it more closely, even in the Identity Theory some degree of abstraction is necessary. For instance, when we say "pain is the firing of C-fibres," just to talk of C-fibres firing we need to make an abstraction. After all, individual atoms neither know nor care that they are part of a C-fibre. To speak of C-fibres is to cut up reality in a certain way. To speak of their firing is more so. So even in the identity theory we idetify the mind with some kind of abstraction. The major difference is that I would contend that a much larger degree of abstraction is necessary.

We nevertheless can regard our theory as identifying first-person and third-person mental states. We can regard third-person states (brain states) as particular patterns in the brain, particular abstractions. (There is never anything 'absolute' about a third-person view. We can do whatever is convenient.) To determine these patterns exactly is the domain of the neurophysiologist. These patterns can be exactly the same ones which first-person mental states are identified with.

(2) Functionalism

This is the theory to which our view bears the most resemblance. Functionalism explicitly recognizes the need for abstraction, even if the abstraction of functional states and machines is somewhat arbitrary. The functional state of the brain at a given time determines the relevant information, although the converse is not completely true. There can be functional effects which are not determined by the first-person pattern or information at a given time.

Essentially, functionalism is a third-person theory. It provides a good description of what we refer to when we talk about mental states in the third-person. The theory has never been terribly happy with first-person concepts, such as qualia. The best it can do is to show that such concepts are compatible with the theory.

Apart from the fact that the functional state at a given time tells too much of the story, there is also a sense in which it cannot tell the whole story. Patterns can indeed be represented by functional states, but there is no guarantee that different patterns will be represented by functional states of the same machine. To specify just one machine is too rigid. The more general notion of pattern and information gives us the required looseness.

Nevertheless the two views have a very similar character. The recognition of abstraction in both leads to similar arguments and consequences. In some ways the view of mind as pattern/information can be regarded as looking at functionalism in a different light and drawing some conclusions.

(3) Computationalism

Computationalism can be regarded as the view that consciousness results from information processing. But we have seen that information is inseparable from pattern; so information processing is the same thing as pattern processing. Extraction of information corresponds precisely to abstraction of pattern. So this coincides with our view that we are conscious in virtue of being a pattern in a pattern-processing system.

(4) Consciousness as self-scanning mechanism

The notion of "self-scanning mechanism" is much the same as our notion of pattern processor. A system which can perceive itself directly can do so only through the patterns that it forms. And as we saw, pattern-processing is a necessary condition for consciousness.

Importantly however, this is only a third-person condition. It is a requirement on the make-up of certain systems which might be viewed as conscious from the third-person. Alternatively, it is a criterion on the type of system from which we might abstract a pattern which would be first-person-conscious.

To see this more clearly: from the first-person, mind is pattern or information. But there are countless other patterns in the world besides those present in the brain. Do we want to say that all of those are conscious? No, so we impose third-person criteria on the particular patterns. One such criterion is that they must have some ability for perceiving sub-patterns.

Nevertheless, it is a consequence of our theory that there is something it is like to be any pattern - not just conscious ones. Pretty boring, mostly. To be a static pattern (such as a mathematical object) would be much like being asleep, but without the excitement of dreaming. To be other, dynamic patterns - well, who knows? Such patterns would not possess properties of self-awareness, so to be them would be quite different to being a conscious pattern such as a human. But it seems ridiculous to suggest that third-person criteria should impose absolute restrictions on first-person be-ableness.

(5) Epiphenomenalism

This theory is only plausible because third-person concepts are enough to explain everything that is going on in the physical world - there seems to be no room for first-person concepts. But now that we have seen that the first-person is inseparable from the third-person, such a view is unnecessary. There is a sense in which first-person experience is epiphenomenal and emergent: it is only in virtue of the third-person complexity of the system that a first-person-conscious pattern can exist.

And it is true that the first-person concept of mental events gives us no extra explanatory power in the physical world.

(6) Eliminative Materialism

This view is plausible for precisely the same reason: that first-person concepts give us no extra explanatory power in the physical world. After all, each corresponds precisely to a third-person concept. So why bother with the first-person at all? The answer is simply that I know it is there. There is a fundamental asymmetry in my view of the world. If there are no mental events, the eliminative materialist cannot explain this asymmetry. He must identify me with something. As soon as he has done this, he has made an abstraction.

(7) Double Aspect Theories

The concept of a double aspect theory is quite vague; but our theory could fall under that heading. We can regard the first person and the third person as two different aspects of the same thing: third-person mental events are pattern, first-person mental events are information. Pattern and information are quite inseparable, and can be regarded as two different ways of looking at the same thing: 'pattern/information,' for want of a better name. The two words seem to have quite different connotations; nevertheless if this paper was rewritten, never mentioning information and always talking about pattern, or vice versa, it would remain coherent and meaningful.

It is my contention that pattern bears exactly the same relationship to information as third-person does to first-person, or as structures in the brain do to mind. One way of looking at it: perhaps information is pattern 'from the inside.' Information might be 'what it is like to be a pattern.'

VII Problems and Speculations
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(1) What is information?

One thing that has been clear in this paper is that the concept of information is very hard to pin down. In some ways, there is no 'objective' reason to believe that information exists; it is only because we have minds that we believe it does. It is easy to say that information is in the eye of the beholder - just as pattern is in the eye of the beholder. Nevertheless information does exist. It is there in my mental processes.

Information must be carried by a pattern, but how exactly? In my opinion, the central question of the mind-body problem (indeed the only real question) is "What is the relationship between pattern and information?". Or alternatively, for a given pattern, what is the information it carries? We are asking for a natural mapping from pattern to information. This is what Fodor [3] asks for when he wants an explication of the notion of representation. Phrased differently: is there a natural mapping from form to content, or from structure to meaning?

Perhaps the only natural mapping is the identity map. Maybe information is the same thing as pattern. Indeed, any attempted definition of information is usually remarkably close to a definition of pattern as well. Information is roughly the choice of a certain way that things can be - that is, a certain pattern in reality.

(2) What is pattern?

The concept of 'pattern' is easier to grasp intuitively than that of information, but there are still questions. Do we dignify any subset of reality by the title of 'pattern', or are there restrictions? From our point of view, certain patterns seem more 'natural' than others, but it is this just human prejudice? And what exactly does it mean for two patterns to be isomorphic? Clearly, these questions are closely tied to questions about information. Elucidate the pattern-information relationship, and these questions will probably answer themselves.

According to Descartes, one thing that is absolutely certain is that our minds exist. If we accept that mind is pattern, we are led inexorably into a form of Platonism. Surely we must accept that our minds exist logically prior to our perception of them (for even to speak of perception implies the existence of a mind). And if abstract objects such as minds can be said to exist prior to our perception, then there seems no reason why this should not be true for any abstract object. To be sure, a die-hard Platonist would like to see the existence of some abstract objects (such as mathematical objects) as being independent of the physical universe, whereas our viewpoint does not ensure this. But the conclusion seems strong nevertheless.

(3) Are qualia arbitrary?

Although we have said that qualia are just information, it is easy to get the feeling that there is something 'extra' about them. Colours are the obvious example. There seem to be extra qualitative properties of colours, over and above the information of a certain wavelength range of light.

If there is indeed something extra, we cannot put it into words. In fact it is quite epiphenomenal. The only causal properties of colour are determined by the information of their wavelength, brightness and so on. Furthermore, the feeling that there is something extra is a third-person property of the brain - after all, I'm talking about it now. So it should not be too mysterious. It would seem likely that any being that could distinguish wavelengths of light would have this feeling. The reason is that the information of wavelength is in a sense 'orthogonal' to all other information in perception - this information could be changed without changing any other information. This suggests that the problem does not lie so much with the qualia themselves as with the information.

Information has to be represented somehow as qualia; the question is, is this representation arbitrary? To find a reason why qualia are exactly as they are would be to answer Nagel's plea [5] for an 'objective phenomenology.' I have my doubts that the answer will be found in neurophysiology, as Churchland and Churchland [1] suggest in their discussion of the problem with relation to functionalism. Instead I believe

that this too is tied up with the relationship between pattern and information.

(4) What is the bottom line?

The same pattern can be abstracted from many different substrates, and as we said earlier, it makes no difference to the pattern what the substrate is. But if we are pattern, then the possibility remains open that our substrate is not what we think it is. To be sure, we perceive it a certain way; but it is a common idea that perception does not necessarily correspond perfectly to reality. To maintain simplicity, we would like to think that our perceptions at least correspond to an outside reality. But even then, all that is really necessary is that we have a reality that contains the necessary information.

To give an example of this rather abstract idea: imagine that someone ran a totally detailed computer simulation of our entire universe, keeping track of everything down to the last electron. Then all the information in our universe would be in the simulation, and all of the patterns would be present in the workings of the computer. To the tiny pattern in this simulation which corresponded to me, its view of its universe would be indistinguishable to my view of this one. The pattern would be completely isomorphic to me, containing just the same information. Indeed, who is to say that we are not characters in such a simulation?

Or maybe such a simulation does not even have to be run. Perhaps someone could simply write down the program, or possibly the functions that define the universe. After all, these contain all the necessary information. Perhaps even writing it down is not necessary – in some sense, the function already exists. All this is very speculative, of course, but at least plausible. It leads to interesting conclusions about possible worlds, but there is not space to go into them here.

[1] P.M. Churchland & P.S. Churchland, "Functionalism, Qualia and Intentionality" Philosophical Topics, Spring 1981

[2] D.C. Dennett, "Two Approaches To Mental Images," in Brainstorms (Harvester Press, 1978), pp. 174-89

[3] J. Fodor, The Language of Thought, (Harvester Press, 1975)

[4] K. Gunderson, "Asymmetries and Mind-Body Perplexities," in Materialism and the Mind-Body Problem, (Prentice Hall, 1971), pp. 112-27

[5] T. Nagel, "What Is It Like to Be a Bat?", Philosophical Review, October 1974

[6] J. Searle, "Minds, Brains and Programs", The Behavioural and Brain Sciences, September 1980