SEEING THE WORLD

(A WINDOW TO YOUR CONSCIOUS MIND)

INDEX

CHAPTER 1
INTRODUCTION

What I am proposing is a way of understanding aspects of what you experience – "what you are conscious of".

This would seem one of the most obvious things for psychologists to study. But psychologists have been intimidated through the ages by philosophers, particularly those who specialize in the "philosophy of mind".

Philosophers put forward conflicting notions that result in consciousness being a "mysterious" phenomenon - such notions as:

- it is not like anything in the physical world
- our mental world is completely different to the physical world
- I can never know whether what I experience is the same as your experience.
- there is an "explanatory gap" between explaining how the brain works and explaining what "produces consciousness".
- It gives humans a distinguishing ability – "free will".

In no time at all, any philosophical discussion becomes submerged in complex argument – can zombies or robots or machines be conscious, can brain events "cause" consciousness, what accounts for the "unity of consciousness". The arguments get so complex and difficult that mere mortals are almost certain to throw up their hands and retreat in confusion.

All of this reminds me of the tale (probably an urban myth) of learned mediaeval scholars sitting around a table debating how many teeth there are in a horse's mouth. They are horrified when the novice (his mind in turmoil from the cut and thrust of such learned argument) suggests simply going outside, opening a horse's mouth and making an actual count.

The point of the fable is that scientific progress depends on describing, observing and measuring what is <u>actually</u> happening. Scientific theory is based on these observations and measurements. In contrast, philosophers of mind like to indulge in "thought experiments". I can admire the cleverness of these arguments, but at the end of the day I am left wondering how my understanding of consciousness has been advanced in any way.

Instead of going down to the path of trying to tackle the philosopher's arguments, I want you instead to get your understanding of consciousness straight from the horse's mouth. We can do this by examining what goes on when you "see the world". Let us simply understand what is actually happening.

It is hoped that this account will make it much clearer what is going on when you "see the world". And because a key to this is understanding the conscious content of seeing, you will then be far better equipped to discuss consciousness in a scientific manner.

Our eyes are typically taking three snapshots <u>every second</u>, each of these with a corresponding momentary visual experience which usually will differ from the preceding experience. The difference may be very minor or quite major, depending on what task we are involved in – are we closely scrutinizing some object, or are we just looking around?

Because of the seamless way in which the conscious visual fields merge, and because this is part of a never-ending process of seeing the world vital to our ongoing interaction with the environment, we are paying little heed to how each momentary visual experience is changing. Instead we are concentrating on selecting information about the external world which best serves the task in hand.

CHAPTER 2

THE VISUAL EXPERIENCE

Vision gives us sensory contact with the external world for most of our waking hours.

It is so central, so vital to our interacting with the world around us that your first reaction would probably be to say – what do we need to understand? We all know what is going on, we are using our vision all the time with rarely any problems.

2.1 The "Visual Experience"

The first thing to be clear about is that the events that occur when you are seeing the world are events that are going on in your head – events you are conscious of.

To be clear about what is going on, you need to perform a simple test. Unless you do this test yourself, you will not be clear about the conscious visual event which occurs.

CLOSE YOUR EYES FOR A FEW SECONDS. OPEN THEM BRIEFLY AND THEN CLOSE THEM AGAIN. SOMETHING HAS HAPPENED – WE WILL CALL THIS A VISUAL EXPERIENCE.

We will use the term "momentary visual experience", to describe this event which happens at a single moment in time. As we will discuss later, seeing the world involves an ongoing sequence of visual experiences which merge into each other in a very complex but seamless way.

To gain understanding about what is going on when we "see the world", the best starting point to examine is the momentary visual experience – this then acts as a basis to look at the ongoing sequences of visual experiences.

There are some crucial things to notice about the momentary visual experience.

A) The "event" that occurred is something going on in our brain. It only happens if our eyes are open and stops happening when our eyes are closed.

B) The momentary visual experience is something we are aware of, something we are conscious of – it is part of our conscious experience.

C) The event which happened can be described in ways about which careful observers are in agreement. These descriptions can then form the basis for scientific knowledge about this aspect of the "seeing" process.

2.2 Description of the Momentary Visual Experience and Scientific Method

We usually describe what happens in terms of the external world:
"I see a banana on the table"
"I see trees in the park through the window".

It also makes sense to describe the event which happens in terms of a three-dimensional field of colour, much as we would describe a coloured photograph. The important point is that we can describe the occurrence, and be clearly understood by our listeners as to what we are describing.

Not only this, but if our listeners are "looking at the same thing", they will usually come up with an identical description of their momentary visual event.

Say we have ten people sitting in a darkened room looking at a screen, and we flash a picture of a banana on the screen for one second. If we then ask what they saw, what colour was it, how long was it, how ripe was it – we will be very surprised if there is any real difference in their answers.

The crucial point here is – ten people have had a momentary visual experience, which they have described in virtually identical terms. A reasonable scientific conclusion from this is – the ten people are having virtually identical conscious visual experiences.

Science has the means to detect and elaborate on variations which may occur – e.g. different experiences for people with certain types of colour blindness, or for people with macular degeneration. The important point being made here is that the momentary visual experience can be studied scientifically through people describing their experiences in defined situations.

It is at this point that many philosophers will say – "Only I can experience my momentary visual experience. How can I know whether what you are experiencing is identical (even if you describe it in similar ways)?" Their implication is that mental events are completely different to physical events, or on a different plane altogether, and intrinsically not amenable to physical description.

The scientist will answer – "If we all agree that something happens in a defined situation, and we all describe what happens, what is going on, in virtually identical terms, then we have the potential to build a body of knowledge about such events". Science is not really interested in your debate about whether things described in the same way are really the same, if you haven't any hard evidence that they are actually differing.

Ten people were in the black-out room when the banana flashed on the screen for one second. Ten people said something happened; they saw a ripe yellow banana about ten centimetres long. Science can assume that all ten had momentary visual experiences which were virtually identical.

Scientific method can distinguish situations where people grouped as red-green colour blind will describe the event differently (but then in similar terms to others in this grouping).

2.3 Visual Experience Becomes the "Real World"

How do we react to these visual mental occurrences going on in our brain?

We do not think, "There is a visual experience going on in my brain, from which I deduce there is a ripe banana on the table two metres away to my right".

Instead we imagine (we act as if) our ongoing sequence of visual events **IS THE REAL WORLD**, with ourselves "looking at" aspects of this real world that are relevant to us.

When you think about it, this is an incredibly useful (probably essential) way of proceeding with our lives. There is a world out there of objects of different shapes and colours, located in three-dimensional space relative to the onlooker. Locating and observing and reacting to these is vital to our survival.

So I say, "I see a ripe banana on that table over there". The last thing I am considering is that there is an ongoing movie sequence in my brain. I take my "brain movie" to be the real world, which I "look at" and "scan" to find out about things I need to deal with.

Suppose you were led blindfolded into a room,and then had the blindfold lifted for only three or four seconds. In that brief time you would know the location of most of the major items in the room, all based on your "brain movie". What an incredible ability!!! Compare this to the blind person's task to establish the location of all the objects in the same room.

2.4 What is the "Real World?"

Be clear that the visual experiences cease when we close our eyes. Fine you will say – but the objects are still out there, coloured objects in three-dimensional space. Their existence is not dependent on being looked at.

No dispute that the physical objects continue to exist – but consider how the person blind from birth conceives the existence of the real world. This person must rely primarily on senses of touch and hearing to position physical objects and to have expectations of their physical characteristics. However, colour – such a prominent identifier in the sighted person's "real world" - must only be a problematical learned factor in the blind-from-birth person's real world concept.

The physicist will tell you that "colour" does not exist in the real world. What exist is light energy. Physical objects absorb some of the light energy falling on their surfaces but reflect the rest as various wavelengths specific to those particular objects. These wavelengths themselves do not have colour. However, humans experience wavelengths within the range 400 to 700 nanometres falling on the retina as a range of colours from red to violet, and are able to differentiate incredibly fine gradations of these colours.

Perform the test at 3.1 again – you will want to say, "I can see a banana which really is yellow". But it is the banana area in your visual experience which really is yellow; the banana out in the real world is emitting light of a certain wavelength which we perceive as yellow. If it gets dark enough, the banana will stop emitting light – does it stop being yellow?

We are so hooked into the idea that our visual experiences are the real world that we would probably say, "Yes, the banana still is yellow, it just doesn't have any light shining on it".

The crucial point is that the conscious events which occur are central to our concept of the real world, and to us these actually become the "real world". The physicist will say the banana is a fruit reflecting light of certain wavelengths when light shines on it. The casual bystander will be adamant that the banana really is yellow. The person blind from birth might make more sense of the physicist's view than that of the bystander.

From an evolutionary point of view, the senses have evolved selectively accordingly to their usefulness in conveying information about the physical world that is virtually relevant to the survival of each particular species. Instead of dealing with the ongoing "movie" sequence of photographs going on in our brain as events requiring to be analysed, to us the sequence becomes the real world, which we are looking at and examining.

2.5 The Importance of Colour

Of all the senses, vision in an instant gives us the means to locate and identify the range of objects in our immediate locality. Just in black and white this would still be incredibly useful, but the added quality of colour gives us a huge increase in available information.

The colour component of vision is quite amazing, analyzing only a very tiny band in the middle of a huge spectrum of wavelengths, from gamma rays at the higher-pitched end to radio waves at the lower-pitched end. Yet this colour identification becomes a crucial aspect of what we think "real" objects are – bananas are yellow, leaves are green, oranges are orange. We can make very fine distinctions about gradations of colour, to tell the ripeness of the banana, how well cooked the food is etc.

Colour conveys a wealth of information about environment, instantly available in the visual field. So it is completely understandable that we conceive of colour as a vital property of objects in the real world. (And we are not interested in how or if the banana reflects other wavelengths such as gamma rays or radio waves).

The overwhelming importance of vision for man's interaction with the external world links in to man evolving as a creature of the day. Primitive man needed to carry out his food-gathering activities in daylight hours. Once darkness came, only fire or bright moonlight would let him employ his visual ability.

2.6 Description of the Momentary Visual Field

Carry out the procedure once more – eyes closed, open for a moment, close again. Describe what occurs.

I expect you would describe it in a way similar to describing a photograph – a coloured patterned field, objects of different shapes and colours at different depths.

Psychologists have performed many experiments to learn more about this field, and some surprising facts emerge about what you experience as a relatively uniform field. Many of these findings correlate to particular physical features of the eyes, and we will look at these in more detail in the next chapter.

Here is a quick summary of features of the momentary visual field, which may seem surprising given that the momentary field appears to be a relatively "even" field (as in a photograph):

i) Visual acuity (the ability to distinguish fine detail) is greatest at the very centre of the eye, drops off rapidly even 2^0 or 3^0 out from centre, and drops off more gradually towards the perimeter (refer 4.3).

ii) There is a "blind spot", a small area of the field corresponding to where the optic nerve forms a million or so neural axons in the retina converge on this spot to form the optic nerve, a bundle of about a million neurons taking the pattern of neural firing back to the brain. The blind spot is a small circular area about 11^0 to 18^0 out from centre on the horizontal axis. There are no light receptors in this area, so it is not surprising that we can not distinguish detail information in this area. What is interesting is that in the subjective field we experience, this area is "filled in"; we do not have a "blank" area (refer 4.2).

iii) Visual acuity for colour (the ability to distinguish fine gradations of colour) drops off away from the fovea in a similar fashion to detail acuity.

iv) The drop-off in visual acuity is even more marked in "complex" fields compared to simple fields (refer 4.3).

2.7 The Visual Experience as an "Evenly Distributed Photograph".

Do the test again (eyes closed, opened, closed). Isn't what you experience just like an "even" photograph? Isn't it a surprise to know that an object at the very central point of the field is there in far greater detail than there is in the same object 10^0 from centre – they don't seem different.

What we instinctively do when we want to see an object in fine detail is to "look straight at it". We focus our eyes on that object without a moment's hesitation – we have learned how to do this so that it is deeply ingrained, it has become a reflexive action not requiring a conscious deliberate action.

Figure 1. How Do the Trees Appear?

What is instructive is that the object we are looking straight at does not appear any different to when we were not looking straight at it. Do the eyes closed/opened/closed test twice on Figure 1, in the first test with your eyes looking at A and in second test with your eyes looking at B.

The two trees "look the same" in our visual field, whether we are looking straight at them or 20^0 away. However, experiments show we are taking in far more detailed information about the tree we are looking sraight at, and as we will soon discuss, this is of crucial importance in selecting our ongoing visual fields.

There seems some sort of anomaly here – the momentary experience appears to be an "evenly distributed photograph", yet when tested there is far more information available at the very centre of the field. What is going on here?

What I am suggesting is that the "evenly-spaced photograph" visual event has evolved in this way so that it is easier to treat the merging sequence of "evenly-spaced photographs" as the real world out there.

If each experienced field had a "hole" in it corresponding to the blind spot, if each field looked increasingly fuzzy away from the central point, if each field had brighter sharper colour in the centre which faded towards the periphery then it would be far harder (maybe impossible) to deal with the sequence of such "photographs" as somehow being the real world which we are going to look at.

I imagine it would then require a far more complex learning process to develop a concept of objects and events in the surrounding world. Imagine watching a movie with a sequence of frames sharply clear in the centre but becoming fuzzier in detail and fading in colour moving out from centre, and a blank hole "blind spot".

It is such a useful way of dealing with the world, to be able to say that the television set "looks the same" whether you are looking straight at it or 20^0 away from centre. Never mind that you would find it terribly difficult to watch the program if you focused 20^0 out.

There seem to be two parallel processes going on. There if the conscious experience, a sequence of seamlessly merging "evenly distributed" fields which we conceive as being the "real world out there". This is an incredibly efficient way of orienting ourselves within the real world. But simultaneously we are selecting ongoing fields to provide us with more detailed information about aspects of these fields which are of most use to us.

You get your "world view" of where objects are and where they are located from the "photographic" sequence, the "experience movie". This does not prevent you dealing appropriately with the TV – you simply "look at it" if you wish to watch it in detail.

An interesting thought is the parallel between considering our "brain movie" to be the real world, and being able to enjoy a real movie.

2.8. "Looking at the World"

We have focused on two aspects of the momentary visual field:-

(a) the event itself, which we experience as a "uniformly distributed photograph".
(b) in spite of this apparent uniformity, surprising differences between the amount of detailed information available in the central field and the amount available as we progress outward from the central point.

We have hypothesized that (a) has evolved in this way so that successive images (which merge seamlessly) can then "become the real world" – we don't for a moment consider this succession, this "brain movie", as being in our head – instead, for us it somehow "is the real world".

We then usually, with no deliberate thought about what is happening, "look at" aspects of this real world which interests us, which are most relevant to whatever task we are undertaking at that moment. We do not realize that we are making use of (b), the enhanced information at the central point of the visual field.

Both of these are made possible by the amazing ability of our eye muscles to take three snapshots every second; this will be the subject of our next chapter.

In short, there are two vital processes in play. Having the seamless ongoing sequence of experienced visual fields is a key part of orienting ourselves in the real world. "Looking at" objects in this field (choosing what is in our central vision) lets us analyze the object being looked at in greatest detail.

CHAPTER 3

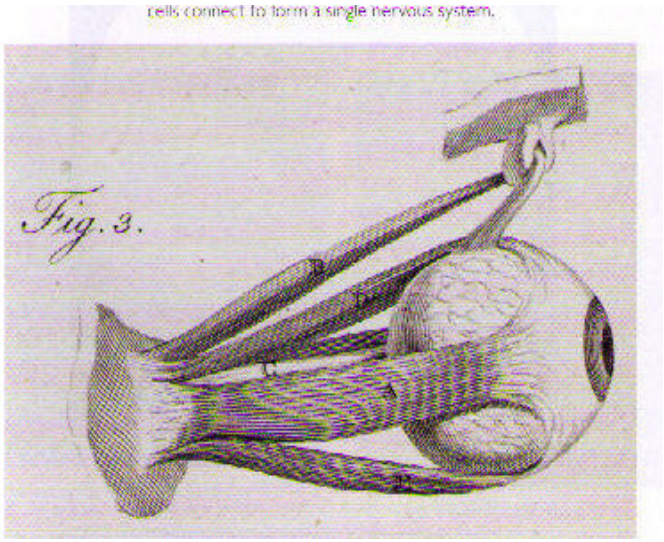
ON-GOING VISUAL EXPERIENCES

3.1 Eye Movements and Adjustments

Our eyes are not simply fixed in our heads. They have a shutter at the front, the iris, which regulates the amount of light entering the eye, and a lens which determines the focal plane of the retinal image. Images of objects outside the focal plane will be blurred.

As well as these two mechanisms within the eyes, each eye has three pairs of extremely specialized muscles which aim the directions the two eyes are pointing (Figure 1).

These eye muscles are incredibly specialized to act very rapidly, and differ in their mode of action to all other muscles in the human body. There are three pairs of muscles in each eye, pulling horizontally, vertically, and rotationally. Not only this, but the two eyes are synchronized so that the images on the retina are matching.



The musculature of the eyeball according to the nineteenth-century American phisician David Hosack. (taken from Simon Ings. 2007. *The Eye A Natural History*, London: Bloomsbury)

Figure 2. Musculature of the Eyeball

Other muscles also work in pairs, but in the mode of "agonist – antagonist" – one pulls while the other resists. This allows muscles in general to have very precise and controlled movement.

In contrast, the eye muscles act <u>ballistically</u>. One eye muscle pulls on the eye to change its direction, while the paired muscle relaxes and does not oppose the movement. These rapid flicking movements are called saccades.

This ballistic ability allows the eye muscles to act <u>incredibly quickly</u>, and the eyes are never still. Figure 3 shows saccades taking from 0.01 to 0.02 seconds to move 1^0, up to 0.05 to 0.06 seconds to move 18^0.

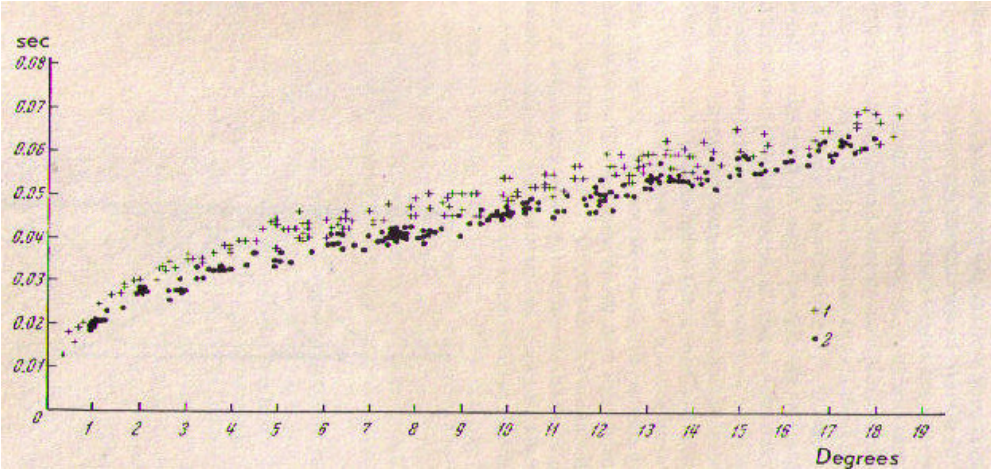


Fig 73. Graph of duration (in seconds) of horizontal saccades of the eye as a function of the angle (in degrees) through which the eye turned when changing the points of fixation. 1) Subject K; 2) Subject P. (From Yarbus, AL. 1967. *Eye Movements and Vision,* New York:Plenum Press, p132)

Figure 3. Duration of Saccades in Relation to Extent of Movement

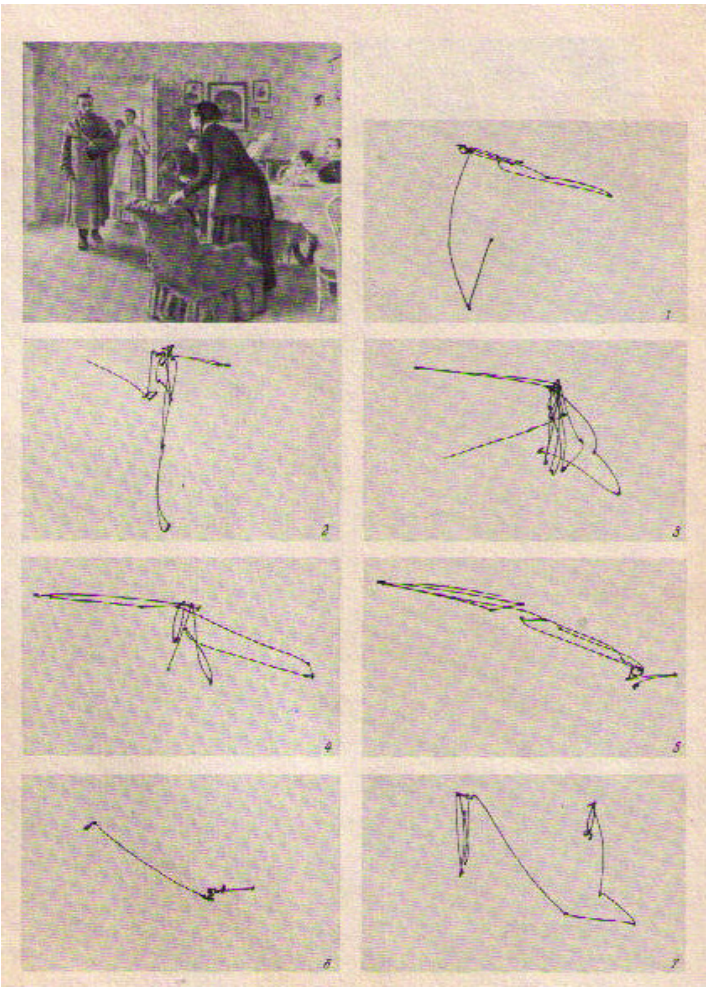


Fig 111 is a record of the eye movements for 35 seconds during free examination. The recording is divided into seven consecutive parts of 5 seconds each. The number of fixations in each part of the record is: 1, 18:2, 16:3, 18:4, 14:5, 17:6, 13: and 7, 15. (From Yarbus, AL. 1967. *Eye Movements and Vision,* New York:Plenum Press, p176)

Figure 4 Eye Movements - "An Unexpected Visitor".

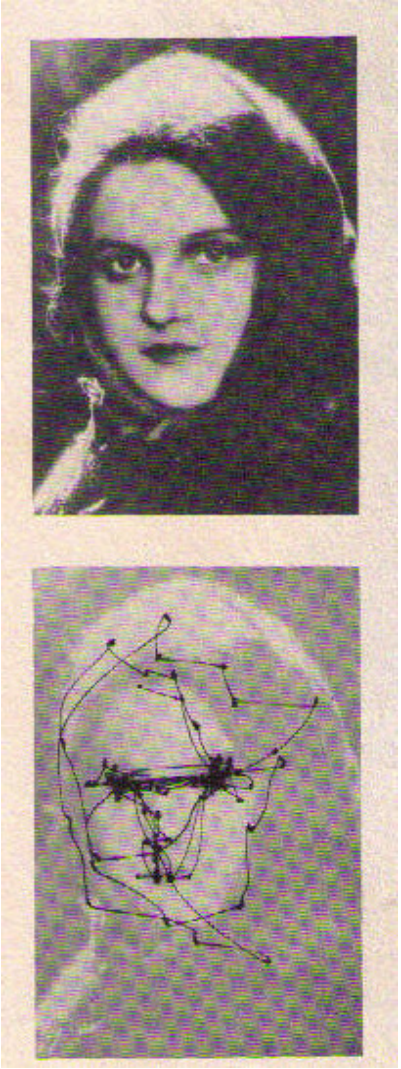


Fig 114. Photograph of a girl's face. Record of the eye movements during free examination of the photograph with both eyes for one minute. (From Yarbus, AL. 1967. *Eye Movements and Vision,* New York:Plenum Press, p179)

Figure 5. Eye Movements - "Photograph of a Girl's Face

An eye movement record of a person looking at a photograph will typically show the eyes still for perhaps 0.2 to 0.4 of a second before flicking to another spot where they again remain still for the same brief period, and continually moving in this fashion.

So, if a person has "looked at" the photograph for thirty seconds, the eyes have stopped still perhaps ninety times, effectively taking ninety "snapshots".

The Russian scientist, Yarbus, published a valuable work on the role of eye movements in vision in 1967. Diagrams of his results show there is a clear information-seeking pattern in the eye movements (Figures 4 and 5).

Some interesting observations in his book:

(i) If the image on the retina remains unchanging, it will quickly fade (within 1-3 seconds), so movement of the retinal image is essential for vision.

(ii) Because of the high velocity of eye movements, the retinal image (between saccades) is stationary on the retina for about 95% of the time.

(iii) During the saccade, no visual images are formed, because the high velocity of the retinal image leads to "blurring" of everything following within the field of vision.

In spite of knowing that the eyes are taking continuous 0.3 second snapshots, and that with the changing central fixation point in each of these, there may be great differences in perceived detail between the snapshots, virtually all works on visual perception seem to treat the role of eye movements as a mere curiosity. Scientists theorize about visual illusions without analysing the sequence of events which result in "seeing" the illusion.

3.2 The Seamless Merging of Visual Experiences

What happens when we look at a 180^0 vista? Look 90^0 to the right, pan your eyes back to centre and then 90^0 to the left.

We would probably describe our experience as "looking at" different aspects of an unchanging real physical world. There does not seem to be any noticeable change going on in our experiences, except maybe that we are "looking at" different (changing) parts of the real world.

Now look at the same 180^0 vista through three snapshots. Close your eyes, take a first quick snapshot 90^0 to the right, close eyes and snapshot to front, close eyes and snapshot 90^0 to left.

You will experience three discrete and quite different momentary visual experiences. Why do these three distinctly different fields seem so different from the "seamless" ongoing everyday experience as you move your eyes around the 180^0 vista? I have tried to highlight this contrast figuratively in Figure 6.

How it looks as we swing our eyes quickly through 180⁰.

How it looks when we take three quick snapshots.

Figure 6. Illustration of the "Seamless brain movie"

There are two main factors at play:

(a) the seamless merging of visual fields (as contrasted to what we might expect, a noticeable staccato change of fields).

(b) the useful ability to react to these seamlessly merging experiences as "looking at" different aspects of an unchanging real physical world.

Our account says that in one minute there may be ninety different momentary visual experiences – for each 0.2 – 0.4 second period that the eyes remain still and focused on a particular point, there is one individual momentary visual experience which corresponds in a unique way with the unique retinal image.

However, this sequence of visual experiences clearly does not happen in a staccato fashion; instead there is a "seamless" merging of the visual experiences.

We can obtain a key insight from the projection of sequential movie frames onto a screen. As the sequence is slowed down, there comes a point when the sequence becomes staccato.

As discussed in Yarbus' work, saccadic movements of the eyes are at very high velocity – from 0.02 seconds for a 1^0 movement to 0.06 seconds for a 18^0 movement (refer Figure 3). So the "snapshots" are occurring with gaps of say 0.02 to 0.06 seconds between them, and for 95% of the time there is a stationery image on the retina.

Allied to this, Yarbus suggests that during the saccadic movement, the image is travelling at such high speed, it is blurred and not seen.

What causes the merging of these snapshots which are are separated by a very brief time?

As a tentative explanation, there is physiological evidence of "persistence" of firing in the optic nerves after stimulation of the retina ceases, correlating to a "fading out" of the visual experience rather than a sudden abrupt end.

This explanation suggests a fading of the first field persisting into commencement of the next visual experience. Bear in mind that eye movements are usually quite small, so that most of the "objects" in the second field are by and large the same objects in the first field. Also bear in mind these are all happening very quickly, with each field only being 0.2-0.4 seconds duration.

3.3 Visual Information Processing

What we "experience" is a seamless, ongoing sequence of visual fields. It is being suggested we should analyze and understand this in terms of:

(i) how the momentary visual experience is related to the external world.
(ii) Selection of the ongoing sequence of visual experiences
(iii) Learned responses to these.

Physiological evidence suggests that the momentary visual experience only lasts for 0.2-0.4 seconds, and in this split second, the eye muscles have to be directed as to where they are to flick to next. This is taking place incredibly quickly at a subconscious level – we rarely consciously pause to think, "where will I look next?"

If we examine at what is going on from an information-processing point of view, we have a momentary visual experience with far more detailed information available around the central point, but also with an array of coloured shapes and patterns displayed over a wide field.

If there is some object in the field we wish to "concentrate" on or to analyze in more detail, it is to be expected that the sequence of eye movements will have their focal points concentrated around this object. The object being inspected will remain in the central area of the sequential visual experiences, although each momentary visual experience will convey greater detailed information about a particular spot on the object.

If on the other hand we are exploring the world, it is to be expected that eye movements will be larger, they will range over a greater area, and they will use more of the information in the peripheral visual experience as a guide for this exploration.

Study of the sequence of eye movements has long been regarded as somewhat of a curiosity in the study of visual perception, instead of being crucial to an understanding of what is probably the most vital process taking place in vision.

And because our brain movie is a sequence of apparently "evenly distributed photographs" seamlessly merging into the next, we are not consciously aware of the process of detailed analysis taking place.

CHAPTER 4
THE MOMENTARY VISUAL EXPERIENCE – SOME DEFINING ASPECTS

4.1 Two Retinal Patterns, Once Visual Experience

The momentary visual experience is of a single field of patterned colour, even though we have two eyes each transmitting neural signals from very slightly differing fields of patterned light.

It seems incontrovertible that there is only a single visual field experienced. Do the momentary visual experience test with one eye covered, then do the test again looking at the same point with both eyes open. The visual experiences seem virtually identical (although there well may be subtle differences between the two situations). Our definition of the momentary field will allow enterprising scientists to look for such differences.

Why this should be, becomes obvious from study of the neural pathways. The two optic nerves, containing about a million nerve fibres, fuse at the optic chiasma. From that point, the optic nerve divides into two parts. Fibres transmitting light from the left half (divided vertically) of the two retinal images combine and run to the subcortical visual centres. (Figure 7)

This mechanism allows a person blinded in one eye or with one eye closed to still experience a complete visual field. Damage to specific points on the optic pathways can be specifically related to loss of specific areas of the visual field (Figure 7).

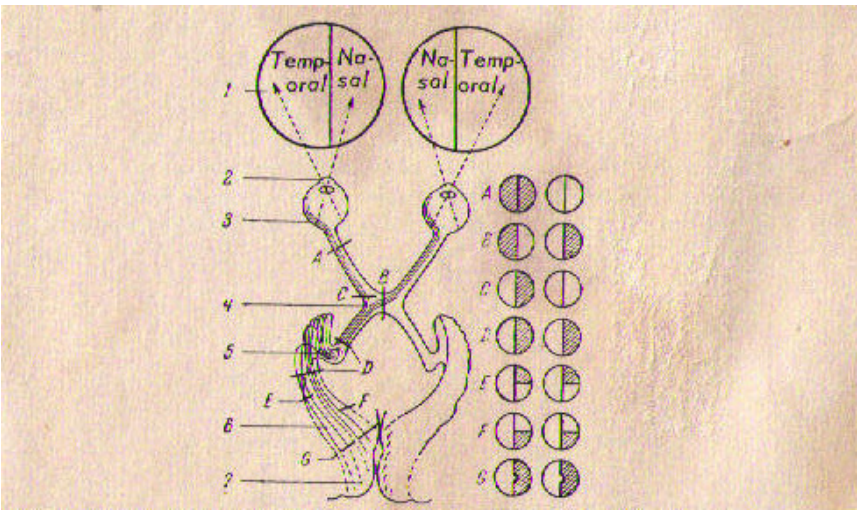


Fig 8. Scheme showing the optic pathways and centres. 1) Field of vision; 2) cornea; 3) retina; 4) chiasma; 5) subcortical visual centres; 6) Gractiolet's fibers; 7) visual cortex. Defects arising in the visual field after injuries to the optic pathways are indicated on the right. The blind area in the visual field is shaded. The point of injury is denoted by a stroke and letter on the figure on the left (Kravkow, 1950). (From Yarbus, AL. 1967. *Eye Movements and Vision,* New York Plenum Press, p11)

Figure 7 The Optic Pathways

The visual field can be mapped as projecting onto specific areas of the cerebral cortex (Figure 8)

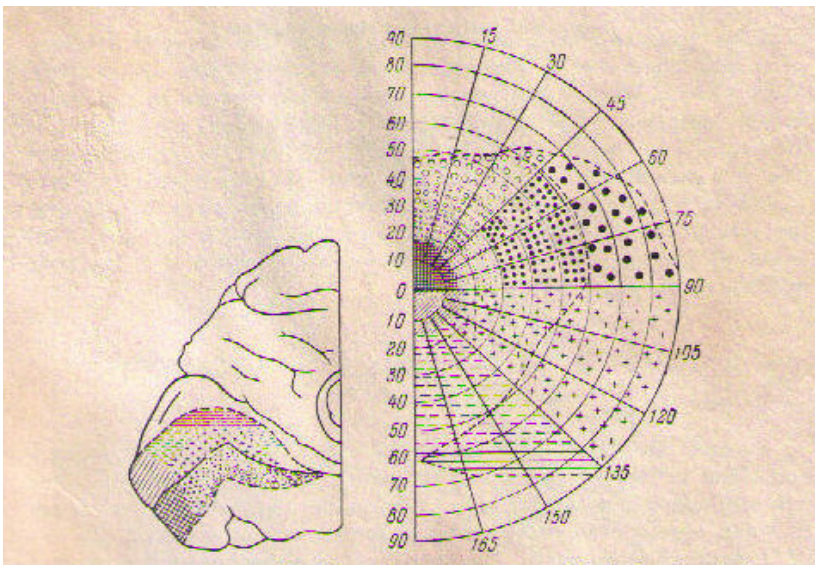


Fig 9. Projection of visual field on the cerebral cortex. The numbers denote degrees (Holmes, 1918). (From Yarbus, AL. 1967. *Eye Movements and Vision,* New York Plenum Press, p12)

Figure 8 Projection of Visual Field on the Visual Cortex

This separation of neural impulses from the left and right sides of the retinal field, and their transmission to opposite (but adjoining) areas of the cortex, does not explain why we experience a single continuous field and not two separate left and right fields. I leave this to scientists familiar with the neurophysiology of the brain.

Our contribution to this knowledge – our momentary experience is a "continuous (even) photograph". We have already hypothesized how having a visual experience of this nature, and the merging sequence of these, leads us to conceive of these as actually being the real world, which we scan and look at. Once again, a visual experience separated into left and right sides, with a horizontal separation in the centre, would make it difficult to view the merging sequence as actually "being" the real world.

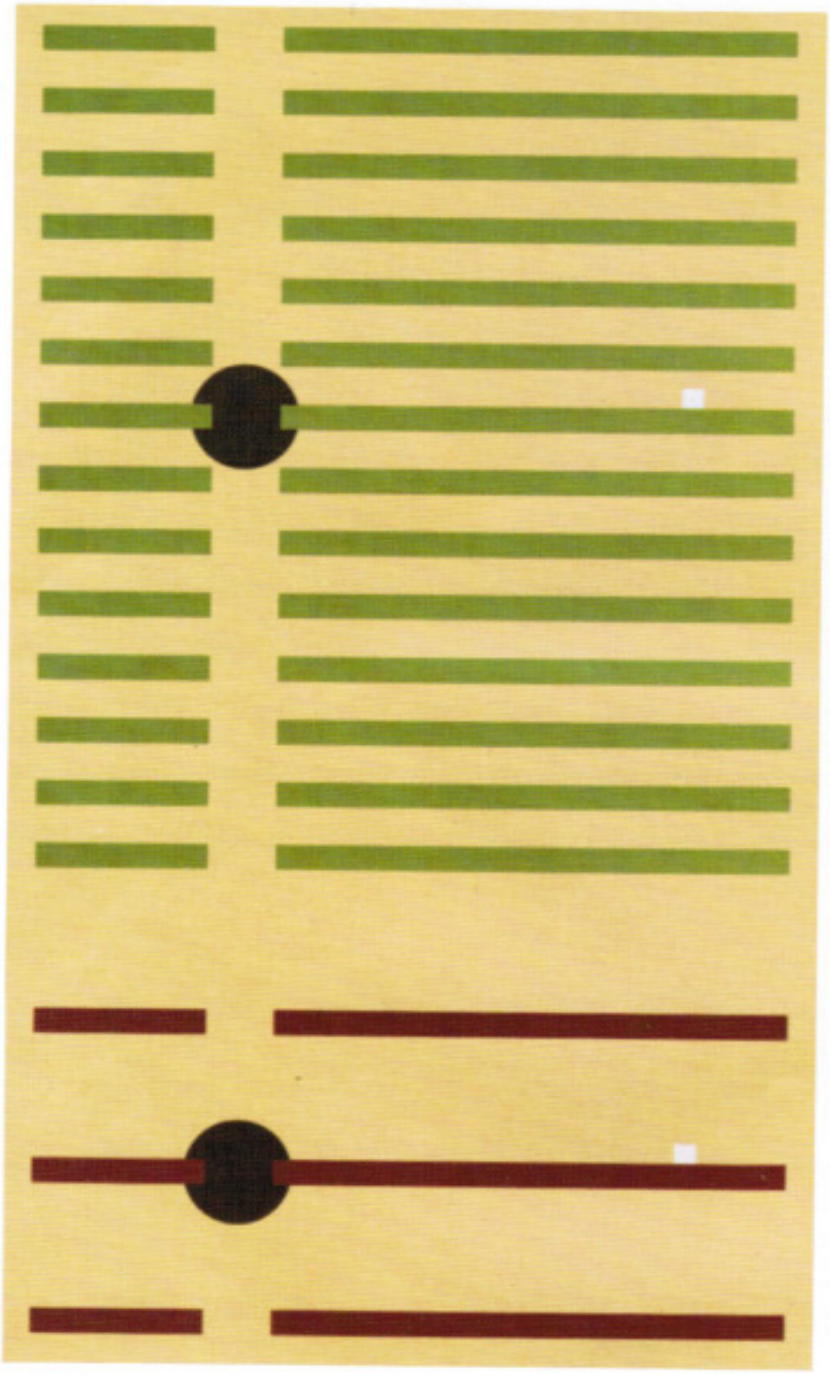
4.2 The Blind Spot

It is known that there is a "blind spot" on the retina, an area where nerves from the light receptors converge to form the optic nerve taking their impulses to the brain. There are no light receptors in this small circular area.

The blind spot is shown as a missing band in the acuity diagram below, from about 11 to 18 degrees out from the central point (the fovea) along the horizontal axis. Yet the momentary visual experience does not have a "black hole"; what we are aware of seems a continuous patterned field. In practice, because the eyes are moving so rapidly and so often, loss of information about a particular spot in the environment will normally be very momentary.

What to me is most fascinating about this is that you do not experience a "hole" in your momentary field – the hole is "filled in". This seems to be part of the process to make the momentary field an "evenly distributed photograph", which we hypothesize to be critical for the seamlessly merged photographs to "become" the real world.

There is already research into the relationships between the blind spot on the retina and momentary visual experiences - how the area in the visual experience corresponding to the blind spot in the retina is "filled in".



Optical illustration devised by Vilayanur S. Ramachandran illustrates the brain's ability to fill in, or construct, visual information that is missing because it falls on the blind spot of the eye. When you look at the patterns of broken green bars, the visual system produces two illusory contours defining a vertical strip. Now shut your right eye and focus on the white square in the green series of bars. Move the page toward your eye until the blue dot disappears (roughly six inches in front of your nose). Most observers report seeing the vertical strip completed across the blind spot, not the broken line. Try the same experiment with the series of just three red bars. The illusory vertical contours are less well defined, and the visual system tends to fill the horizontal bar across the blind spot. Thus, the brain fills in differently depending on the overall context of the image. (Johnny Johnson)

Figure 9. Filling in the Blind Spot

4.3 Ability to See Detail (Detail Acuity)

Most of the acuity studies have been carried out with very simple visual fields – a spot of light for a focal point and an acuity object to be identified.

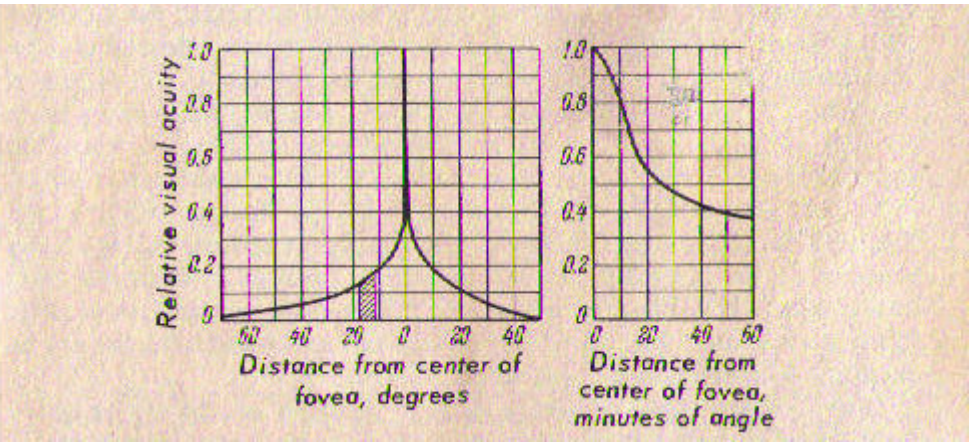


Fig 6. Relative visual acuity depending on the position of the retinal image of the retina.
(Jones and Higgins, 1947). (From Yarbus, AL. 1967. *Eye Movements and Vision,* New York Plenum Press, p9)

Figure 10. Visual Acuity and Central Fixation

As a student, I carried out some unpublished experiments which suggested that, in more complex visual fields, there was an even more dramatic drop off away from the central point of vision in the ability to detect detailed information.

For example, when single letters of the alphabet of a particular size are flashed on a screen, the average person might still identify these letters up to 8^0 out from the focal point. However, when subjects were asked to identify the central letter out of three flashed on the screen, the point at which they were able to do this was much closer to centre (Figure 11).

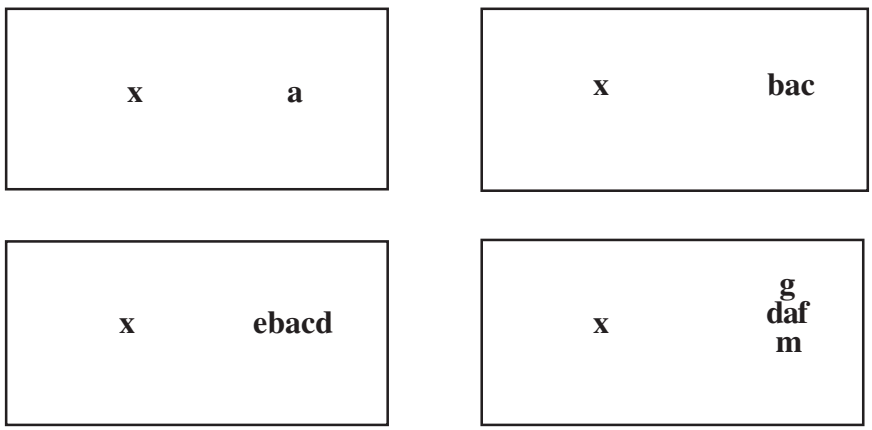


Figure 11. Loss of Acuity in Complex Fields

Research regarding acuity, or ability to detect detailed information in various locations in the visual field and in simple and complex patterned fields, would seem essential to understand the momentary visual experience.

In particular, my preliminary work seemed to be showing that in complex visual fields, there is a fairly rapid drop-off in the ability to detect detailed information away from the central focal point. This could suggest that we use the central field for detailed information analysis, and the peripheral field for direction-finding to tell our eyes where to go next. The more complex the field, the more difficult this analysis is likely to be.

4.4 Depth Information from Convergence Information

In the case of close objects, we are able to use convergence clues – the slight divergence of images from the two eyes – to judge depth.

Is this "convergence factor" reflected in the visual fields we experience? Or is it utilized in some other way, not reflected in the visual experience itself? I do not profess to know the answer, but clever research should be able to provide greater understanding.

4.5 Subliminal Perception

The framework also gives a clearer method of defining "subliminal" visual perception. If something is "perceived" (reacted to), it can hardly be said to be subliminal.

What we are really talking about are visual stimuli which can react to without being "aware" or conscious of them (i.e., they are not occurring as part of the visual experience)? Perhaps some of the convergence clues fall into this category.

CHAPTER 5

APPLICATION OF THESE CONCEPTS TO FIGURE-GROUND, CAMOUFLAGE, AND ILLUSIONS AND NONSENSE FIGURES

Introductory textbooks in visual perception usually have examples considered in some way puzzling, but in any event important for understanding the visual process.

This chapter will look at some of these puzzles, analyzing them in terms of the conceptual framework previously set out.

5.1 Impossible Figures

In Figure 12, we have what might be called an "impossible" figure. At the left end it appears to be three threaded round bolts, but at the right end a U-shaped object with two arms and a square cross-section. Because this is incompatible with any real object, it may be called an "impossible" figure.

Figure 12. Impossible Figure

What I find most interesting about this diagram is that if you look only at the left end, it is impossible to see it as anything other than the three bolts, and not at all ambiguous.

Similarly, if you look only at the right end, you can see it only as the U-shaped object, square in cross-section, with two arms extending to the left. Staying focused at this end, there is something fuzzy out to the left at the end of the arms, but you cannot see this in enough detail for it to be conflicting and ambiguous.

This highlights the point made in an earlier chapter about the progressive loss of ability to see detail in complex fields as the detail gets further out from the central fixation point.

However, if you are allowed to freely scan the diagram, you can see that it can appear as either of two different objects depending on where you are looking. You know that this cannot represent a real object. Is this puzzling? Not if you follow our account – what is in your central fixation, what you are looking at, is seen in clearest detail, and what is further out in complex fields is not seen clearly. So if you look at either end, you see it clearly as either one or the other. If you look <u>only</u> in the centre, then you have an ambiguous figure which is <u>not</u> clearly one or the other.

5.2 Figure and Ground

One of the best-known diagrams in textbooks (which formed a cornerstone of Gestalt psychology) can be seen as either a black table or vase on a white background or alternatively, two white faces (the external edges of the vase/table) looking at each other. There is an impression of fluctuation – now it is seen as a table, then as two faces (Figure 13).

Figure 13. Figure and Ground – Faces and Vase

The fact that at one moment one might see only the black table, and at a later moment only the white faces, was taken as evidence that the brain somehow transforms visual information. It was suggested that at one moment the brain is making the black table prominent (figure) and suppressing the faces to become background (ground). A few moments later the same information has been transformed; the two faces are now prominent (figure) and the table has disappeared, becoming ground.

The Gestaltists made much of this dramatic "reversal" of figure and ground. There was an implication that the brain was somehow working on the visual information, converting part of it into figure and relegating other parts into ground. There was never any thought given that what is being inputted to the brain might be changing.

In terms of the current framework, we would examine the sequence of ongoing visual experiences, keeping in mind the acuity pattern in the momentary field.

Experiments could examine the following situations:

(i) If eye movement measurements were to be made, it seems likely that at the stage the black table is being seen as figure, eye movements are concentrating within the boundaries of the black area and the sequence of ongoing visual experiences retains the black area in its central focus. The converse situation might be expected when the two white faces are figure.
As referred to earlier in 3.1 (and Figure 5 in 3.1), Yarbus found that when looking at pictures of the human face, most attention (central fixation) was usually paid to the eyes, the lips, and the n o s e . Can one "see" the faces at all, if the eyes are looking at the top rim of the vase?

(ii) In the situation of the momentary visual experience, do we have the dramatic reversal? If the diagrams flashed on a screen for 0.3 seconds, do we see only one or the other? In other words, if there is only one snapshot of the faces-vase figure briefly flashed to subjects (both naïve and knowledgeable of the phenomenon), does either figure stand out as predominately figure? Does this change for different focal points?

With the momentary field (especially for subjects who have previous knowledge of the diagram), is their experience altered by changing their point of focus when the brief snapshot is flashed upon the screen?

(iii) Does this diagram convey some crucial point about the visual process, or is it merely a curiosity? For example, if the diagram is presented in outline only (ie. the table is now a white table with black outline only), does the dramatic reversal still occur? What happens if the table and faces are merely different shades of grey?

(iv) What happens if a subject is asked to maintain focus at a particular point on the diagram? Does the figure – ground still change? Can the subject consciously make it change? (A problem with an experiment of this type is – we are asking the person to maintain focus on a particular spot, even though we know the eyes are continually making rapid saccadic movements. We would need to find out with an eye movement camera what happens when we ask someone to maintain focus on a particular spot).

There is valuable additional knowledge to be gained from examining the figure-ground effect utilizing the above approaches. Without pre-empting the results, I do not expect them to suggest anything outside the ongoing visual information processing model outlined earlier, and certainly not any process "elevating" some parts of the visual experience and suppressing other areas, at the level of the visual experience. Rather, movements of the eyes are changing ongoing sequences of visual fields, and what is experienced is changing accordingly.

Figure 14. Two Dragons and the Lady's Face

Figure 14 is a modern figure-ground illusion figure. Once again, the prediction (completely testable) is that to see the lady's face, you will need to input eyes, nose and lips. If you focus on the dragons' heads or wings, can you see the lady's face?

Figure 15. Black and White Tights Dance

You can see an amusing and interesting illusion on video at http://www.flixxy.com/black-and-white-tights-dance.htm. There are eight girls linked shoulder-to-shoulder across the stage. Each is in tights-black on one side of centre and white on the other. However, these are in alternate order, so that a girl with her left side in black is alongside a girl whose right side is black.

They perform a dance routine with complicated steps, moving backwards and forwards towards the front of the stage while staying in line and holding close against each other.

The top halves of their bodies have virtually no movement during the dance, except backwards and forwards. The illusion has you looking at the legs; it appears that there are sets of black legs (or alternatively white legs) doing strange, very complex and amusing steps.

There is close analogy here to the old black and white faces vase figure. Your eyes take up on adjacent black legs; you see these as belonging to the one girl who consequently is performing a series of quite amazing steps (or alternatively, a girl in white tights doing some fantastic steps).

What helps create the illusion is that normally, one girl would be either all in black or all in white. You become so fascinated by the steps the black legs are doing, you are not interested in tracking them upwards to work out which face goes with those legs. The girls wear dark glasses to minimise interest in their faces.

The illusion can easily be broken, if you pick say one white leg and keep your eyes fixed on this leg during the dance sequence. You will be conscious of the adjoining black leg which obviously belongs to the same girl. Re-watch the video with this strategy; you can clearly focus on the complex steps which each girl is performing.

The illusion is a great illustration of the theme we are pursuing - the ongoing selection of visual fields determines what we perveive. The central field has a central role in what we perceive; the sequence of central fields determines what we see happening.

5.3 Hidden Pictures and Camouflage

In a typical "hidden picture", there may be a black and white drawing of a complex jungle scene with lots of trees and other objects. We examine the picture for some time until we suddenly "see" the tiger.

A similar effect may be illustrated with a colour photograph of an animal, insect, fish etc. at first undistinguishable from its background environment – camouflage. But once we see the camouflaged object, we can immediately see it next time we look.

Textbooks typically discuss these as further examples of the figure-ground effect. There is not the dramatic "reversal" occurring, but we now "see" a tiger in the picture where we could not initially see it.

What is going on here is a brilliant example to understand our visual perceptual model. In an environment where complex images are falling on the two retinas, the detailed information necessary to identify a tiger is only available in the central foveal area. It is hypothesized that the tiger is not identifiable if the "tiger information" is not in the central area. This can be easily tested in a research situation.

In a complex "camouflaged" world being seen for the first time, the information in the peripheral visual experience does not give the brain the specific clues it needs to direct the eye muscles to the required place.

We know from our instructions that the tiger is hidden in the picture, so the eyes will keep scanning the picture until suddenly, in a focal area giving enhanced detailed information, we are suddenly aware of say the tiger's face. Once this is detected, we can rely on previous learning to direct the eyes where to go next, to focus on the tiger's body, legs and tail.

This approach makes it very simple to understand why, once we have found the tiger, we can look at the picture the next day and see the tiger straight away. We have learnt where we need to direct our eyes, to "see" the tiger. Our eyes immediately focus on the points which give us a sequence of visual experiences with detailed tiger information.

All of the above is easily tested by eye movement photography, and it seems such an obvious explanation I would be highly surprised if it were not so.

Figure 16. The Hidden Tiger Illusion

Figure 16 is a modern version of the hidden tiger. You can see the obvious tiger, but can you see the hidden tiger? A clue – instead of looking through the undergrowth, look for the letters, "the hidden tiger". Now you have the clue as to where is the most obvious place to search.

There is an important insight here into the role camouflage plays for survival of many small animals. In the "hidden picture" situation, we are told there is a tiger concealed in the drawing, and we keep scanning it until we at last focus on the vital clues.

(taken from Roger Carr. 1972. *Protective Coloration and Mimicry, Nature's Camouflage*, Richmond, Virginia: Westover Publishing, p6)

Figure 17. Black Bear Cub

Finding the black bear cub in Figure 17 happens relatively quickly. Having found it the first time, we can see it straight away the next time we look at the picture.

But try "seeing the bear" if you are limited to scanning only the bottom half of the picture. I cannot see the bear with this limitation. Imaging you are in a forest clearing surrounded by hundreds of similar trees – how hard would it be to see the bear if it remained still?

Out in the open world, the predator does not know in which area the potential prey is hidden, or even if there is any potential prey there at all. This means that, if the camouflage is very good, the prey has a very good chance it will not be "seen".

Another example of this is when we can hear an aeroplane high in the sky, but cannot see it at the spot where the sound seems to be coming from. In this case, hearing has given the clue where to look. However, because sound travels more slowly than light, the plane has moved away from the spot where the sound originated.

Because of fall-off in acuity away from the centred fovea, our eyes have to be focusing at a point relatively close to the aeroplane for it to be seen. We might scan randomly out and about from the spot suggested by hearing, hoping to chance on it. A better strategy is if our hearing indicates the direction the plane is travelling, we can then "look ahead of the sound" and quite likely see it.

5.3 Muller-Lyer Illusion

With this illusion, there is a diagram with two straight lines of equal length. One has outward-going arrowheads at the end, the other inward-pointed arrowheads. The straight line with the outward arrows appears longer.

The problem with existing theories is that they assume we are "seeing" a static picture of the two lines. Somehow the brain manipulates this picture, making one line longer and one shorter, similarly to the brain manipulating the faces-vase figure to make one part figure and then reversing this to make another part figure.

Underlying such theories is the notion of a "seen" picture in the brain. However, because researchers felt they could not study conscious experience, they did not want to talk about the experience of a visual scene – even though it was influencing their assumptions about what happens in visual perception.

Yarbus (1967) examined eye movements relative to the Muller-Lyer figures (Figure 18). He found that the distance between fixation points differed for the inward- and outward-fading arrowheads.

However, because the illusion still occurs when the retinal image is stabilized on the retina, he concluded that eye movement has no appreciable effect on the occurrence of the illusion, even though "the presence of illusions appreciably influences the amplitude of the saccades accompanying the evaluation of distances" (P.205).

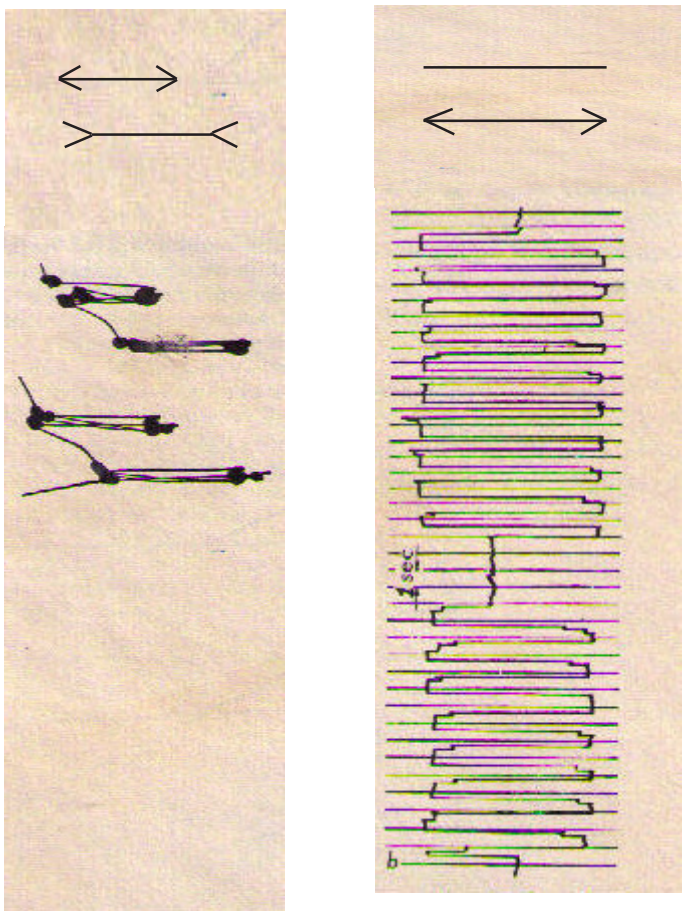


Figure 18. Eye Movements and the Muller-Lyer Illusion

Our account highlights how vital it is to be clear about what is going on with the momentary visual experience, and to use this as a crucial building block to understand the complexity of the ongoing sequence of visual experiences.

To examine the Muller-Lyer diagram in the present conceptual framework, we would be approaching the phenomenon on the basis that when we "see" the effect, we are usually experiencing an ongoing sequence of visual experiences rather than building up a "static" single picture in the brain.

When we are studying the visual field itself, we are examining areas occupied in a coloured patterned field. To go further than this and make judgments about actual lengths often involves further layers of learned behaviours. The crucial question is - does the Muller-Lyer illusion exist as a distortion in the momentary visual experience, or does the "distortion" (incorrect estimation) occur in the ongoing sequence of visual experiences and learned reactions based on these?

Even if there is enough information in the single field (0.2 – 0.4 seconds) to make judgments about length, do we normally make judgments based on this (given that the eyes are never still)? It would seem very likely that we would usually use information from a sequence of fields to make judgments of length, and would rarely base such judgments on a single field.

In considering the effect of the Muller-Lyer arrowheads in the momentary visual experience, I did some experiments as a research student with a simplified figure – a line extending out from the focal point with a single arrowhead at the end, either inward or outward pointing (Figure 19).

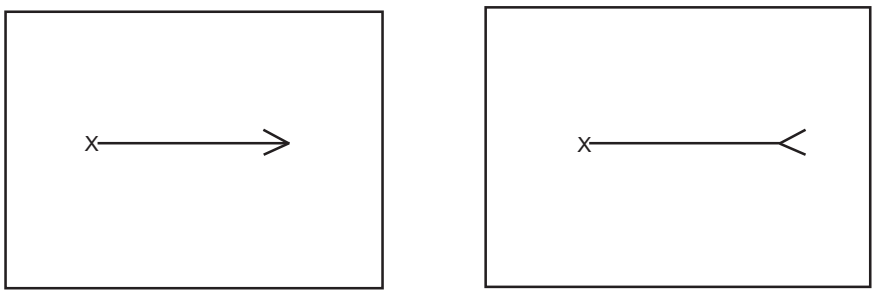


Figure 19. Location of Single Arrowheads in Peripheral Vision

Subjects asked to indicate the location of the end of the line (where it met the arrowhead) made longer judgments for the outward pointing and shorter for the inward pointing, in a manner expected for the Muller-Lyer illusion and discussed by Yarbus for stabilized images.

Is there a blurring in the periphery about the junction point of the end of the line and the arrowhead, with the blur outside the end for the outward arrow and inside the arrowhead for inward-pointing? My work was very preliminary – the effect could be examined for different sized lines, different sized arrowheads, differing line orientations, differing thickness of line. However, the example of the impossible figure in 5.1 illustrates the difficulty of clearly seeing complex detail away from the central area.

I also carried out some very basic eye-movement measuring work, which seemed to be indicating the eyes were travelling to fixation points mainly inside the arrowheads (which would seem to link into the blurring effect mentioned above). If the periphery is giving a distorted effect in the momentary visual

experience situations, the eye muscles would be given signals to go to the inside the arrowhead, which would be either inside or outside the end of the line depending on which way the arrowhead is pointing.

Perhaps when the eyes are directed to go to the end of the line, they are given signals taking them too close or too far. However, once the junction of the line and the arrowhead are in central focus, there should be no distortion. Shouldn't the brain then be able to make a correction for any initial distortion?

I wonder (and I do not profess to know the answer) whether the brain uses feedback from the eye muscles as to how far they have traveled? Muscular feedback is obviously critical for the rest of the body, with the brain monitoring feedback from both the pulling and resisting muscles.

However, the eye muscles are different to all the others – one pulling (almost flicking) the eye while the paired muscle relaxes, doing this at incredible speed in a never-ending sequence. It is conceivable that trying to derive feedback from this fraction of a second flick would slow reaction time.

There is a possible explanation of the Muller-Lyer illusion here. If, in the momentary visual experience, the end of the line with outward arrowhead appears further out (through blurring), and the eye muscles are sent signals to go further out, it will be difficult to correct this initial "error" if precise information about distance travelled by the eye muscles is not integrated into the equation.

CHAPTER 6

FURTHER DESCRIPTION OF THE MOMENTARY VISUAL EXPERIENCE – "MEANING" AND "DEPTH"

6.1 Separating Description from Attached Meanings

Consider the example of a ceramic banana, which is so lifelike that you go to pick it up to eat. Immediately you touch it,you are aware that it is not a real banana, and perhaps you will say it no longer looks like a real banana.

Imagine a scientific experiment where we used brief flashes of light to check the momentary visual experiences occurring for the real banana and the ceramic banana.

I believe that the momentary visual experiences for both are most likely identical. However, you would likely say (if you know which is which) – "the real banana looks different to the ceramic banana".

This expression is saying – a real banana is something which is on the table to perhaps be picked up and eaten, or left as part of a fresh fruit display. The ceramic banana is on the table purely as an ornament; it is more valuable than a real banana and needs to be handled far more carefully.

These overlays of meaning are essential to our efficient interaction with the environment, and utilize more complex uses of the words "seeing" and "looking".

But the crucial factor in examining the <u>momentary visual experiences</u> for the two different bananas is – <u>if we don't know which is which after they are briefly flashed on the screen, isn't it the simplest explanation to say that the visual experiences for both are identical?</u>

You then may well want to say – "After I know that banana is ceramic, it then looks different". I would say – "Fine, this is a useful thing to say. But are you trying to say – somehow my visual experience itself is now changed, and what looked like a real banana now looks like a ceramic banana?"

Or is it more economic to say – the coloured patterned visual experiences occurring in the two situations are identical, but knowing whether the banana is real or ceramic prepares me in quite different ways to react to it. And my ongoing reactions are likely to be drastically different.

Science is always looking for the simplest, most parsimonious descriptions. It provides a far simpler explanation of what happens in our solar system to describe the planets as orbiting the sun, than to say that Earth is the centre of our solar system with other planets and the sun moving around the Earth in incredibly complex orbits.

One point needs to be made early in this endeavour. This work is presenting a conceptual framework for the study of visual perception. Ways will be suggested as to how this framework can be applied to scientific study of a wide range of visual phenomena.

It is very likely that I may be wrong in minor and major ways with some of these suggestions. The important test will be – does this platform overall provide a basis for better understanding of what is happening? And can the concepts be applied to ongoing research to further widen our understanding, including refinement or revision of some suggestions in this account?

6.2 Description in Two-Dimensional Terms

We are focusing on the momentary visual experience – the conscious visual experience which occurs at a single moment in time. Perform the test at 3.1 once again, just to refresh your awareness of what we are discussing.

There would seem little argument in saying – the momentary visual experience can be described as a coloured patterned field, with objects at different depths.

I wish to go further than this, and say – the momentary visual experience can be described as a two-dimensional coloured patterned field.

Your first reaction will be to say I am wrong. You will say that what you experience in the split second if you open your eyes for this test, is a coloured patterned field which also has depth. The banana is in front of the apple on the table, there are two chairs in front of the table and two behind.

What I wish to say is – the momentary visual experience which occurred in the above situation can be described fully and adequately as a two-dimensional coloured field. The banana was a yellow oblong shape occupying a certain part of the field, and so on. In many respects these shapes will coincide with the two-dimensional pattern falling on the retina.

But – you will say – what I see looks three-dimensional, not two-dimensional.

Consider the case of a photograph of the table and chairs and fruit. You don't have any problem saying that the photograph is flat ("looks flat"?), but the table and chairs and fruit in the photograph look three-dimensional.

You could easily say in the case of the photograph, "The table and chairs and fruit are actually flat, but look three-dimensional". You could still describe the photograph in terms of a two-dimensional coloured field, even though it looks three-dimensional.

This is a crucial point – a good painting or a photograph can be described in terms of a coloured two-dimensional patterned field – even though there would rarely be any reason to do this in real life.

In the everyday life, we would almost always talk about what we "see" in a painting, which would include objects looking closer or further away. If, however, we wished to understand how an artist can use perspective to create an impression of depth, we might examine instead the two-dimensional pattern on the canvas.

A student wishing to learn the techniques of realist painting will study how to create patterns on the two-dimensional surface which look real. He or she will learn the rules of perspective, and how a clever dab of white paint can create the look of light glistening on a drop of water on the fruit.

The example of the painting is a good analogy for our methodology of examining the momentary visual experience. The use of perspective in the painting is predicated on "looking at" the scene from a particular point. The momentary visual experience studies the field we experience when we look at things from one particular point.

You may have lingering doubts – you may say, "What I see with a real life table and chairs and fruit looks different to these in a painting, no matter how good the painting is".

But consider the case of trompe-l'oeil paintings, paintings done in particular places which are done so cleverly that the viewer at first thinks he or she is looking through a window at a real scene. (These effects rely on being looked at from a particular spot).

Figure 20. Modern Trompe-l'oeil Paintings

If this thesis of the momentary visual experience being fully describable as a two-dimensional coloured patterned field is correct, we have a platform which may provide a relatively simplified explanation of what is going on. The trompe-l'oeil view and the real view provide identical visual experiences; knowing which is which affects our ongoing behaviour in relation to these fields, but not the pattern of neural activity identical to the momentary visual experiences.

6.3 Implications of Two-Dimensional Description

If the momentary visual experience can be described in two-dimensional terms (even though we always react to it in terms of three-dimensional "meaning"), then science is given the task of examining the relationship between two-dimensional retinal images and two-dimensional visual experiences.

We know that each eye focuses a pattern of light on the retina at the back of the eye. Even though the retina is a curved surface, the pattern of light can be described as a two-dimensional patterned coloured field, albeit lying on a curved surface.

In the case of the ceramic and the real bananas, it makes sense to surmise that if the coloured pattern fields falling on the retina in the two cases are identical, then the corresponding momentary visual experiences occurring in the brain are likely to be identical, and the "difference in how they look" likely derives from different ongoing reactions to the two (which might only occur after we know which is which) – not some strange imposition of "a different look" changing the respective visual experiences.

Go back to 3.1, and once again experience a momentary visual experience, so that you are crystal clear about what this is. Let us go further and surmise that the momentary visual experience which occurs is identical to some physiological activity occurring in our brain.

"Wait a minute", you might say – "If it is a conscious experience, part of our mind, how can it simply be identical to a particular brain activity?"

Are you saying – it is some sort of "out of body" experience? You are free to do so – but science will always look for the simpler explanation. We would argue that the expression "being conscious of our mind experiences" says no more than "an ongoing stream of visual experiences occur".

In the light of current neuro-physiological knowledge, it will be a far simpler task to correlate a visual experience describable in two-dimensional terms with an area of brain activity, than it would be if the visual experience actually is three-dimensional.

Textbooks in the area of visual perception invariably discuss how the brain somehow organizes and reorganizes the sensory input falling on the eyes to create depth, or to create an incorrect illusion in the case of the Ames room. The problem is the implied suggestion that this depth is occurring in the occurring experience itself, and this would require an incredibly complex neural system to re-pattern and re-locate the images falling on the retina.

The root of this problem is that none of these accounts are clear about the nature of visual experience (or sequence of these experiences). Once again, go back to 2.1 and perform the test, so that you have a clear understanding of what a momentary visual experience is.

Our simple account is that at the level of the momentary visual experience, what occurs can be described in terms of a coloured two-dimensional patterned field which in most instances more or less conforms to the two-dimensional pattern falling on the retina.

The visual experiences can also be described as having depth and size and other characteristics in the same way that a photograph can, but these are learnt ongoing reactions to the visual field being experienced, not "transformations" of the field.

CHAPTER 7

VISUAL PERCEPTION – A SYNOPSIS

7.1 The Vital Role of Conscious Experience in Understanding Visual Perception

The aim of this section of the work has been to show how visual perception can be studied and understood using the sequence of momentary visual experiences – i.e. using conscious experience, with the conscious events clearly described.

It is precisely because this visual field is being experienced, and can be defined and described in precise ways, that makes it such an important tool.

There are probably "subliminal" visual stimuli to which we may react. The word "subliminal" refers to the fact that we are not experiencing them in our visual field. Research in this area is more difficult because we cannot use descriptions of the visual experience as an investigatory tool.

We must be very careful when using words such as "seeing" and "looking", to distinguish whether we are describing the actual visual experience itself, or whether we are adding layers of learnt meaning regarding ongoing reactions to what is being experienced.

The photograph or the painting is flat and is capable of being described two-dimensionally, even though in real life it would rarely be appropriate to try to describe it in two-dimensional terms. However, the two-dimensional description is appropriate if we are studying the surface of the painting or photograph itself.

We can react to the photograph three-dimensionally (as a representation of the real world) or two-dimensionally (placing it in a photo album). In the case of the momentary visual field, it is hard to imagine a situation where we would <u>not</u> react three-dimensionally.

This distinction is important, because in studying momentary fields, we wish to relate these externally to the patterns of light falling on the retinas, and also to correlate them to patterns of neural firing in the brain.

We are postulating that the momentary visual experience itself closely relates to a composite of the two curved two-dimensional images falling on the retinas at that moment in terms of a coloured patterned field, but with identifiable gradations of information detail depending on the fixation point.

In terms of current knowledge, it seems a far more feasible task for the neurophysiologist to correlate the momentary visual field to a two-dimensional pattern of firing in the brain. If the visual experience was <u>actually</u> three-dimensional, he would be looking for far more complex brain mechanisms than seem evident.

7.2 Visual Perception as Ongoing Data Selection

Our model envisages an ongoing seamless sequence of visual experiences, merging in a smooth progressive way as we "look at the world". But underlying this in the eye sockets, there is frantic activity – the eyes darting from point to point taking split-second snapshots, the retinas converting the light images from each image from light to neural firing, and the optic nerve transmitting these impulses to the brain.

It is crucial that the eyes are continually being given ongoing split-second instructions what to do next, relying on long-established learnt reaction patterns. This ongoing dynamic data-processing model underlies the smooth ongoing visual field experience.

In relation to learning and the momentary visual experience, an important consideration will be to understand how each momentary field is guiding ongoing data selection, as well as the nature of more complex learned judgments as to whether the perceived object is edible or dangerous or interesting.

In the 1967 book, "Eye Movements and Vision", Yarbus examined fixation points of the eyes when subjects looked at complex pictures. As might be predicted, the eyes spend far more time fixated on certain elements, while other elements receive little or no attention.

He found that, when looking at a picture of people in a room ("An Unexpected Visitor"), all fourteen subjects spent far more time fixated on the faces of the people in the pictures than on their figures, and far more time on the figures than on objects in the room (refer Figure 4).

When looking at pictures of the human face, most attention (fixation) is usually paid to the eyes, the lips and the nose (see Figure 5). He noted, "It is curious that, when examining the picture of the lion's head..... and the sculpture of the gorilla....", most of the points of fixation of attention are found on the eyes, nose and mouth of the animals (P. 191).

"The human eyes and lips (and the eyes and mouth of an animal) are the most mobile and expressive elements of the face. The eyes and lips can tell an observer the mood of a person and his attitude towards the observer, the steps he may take next moment and so on. It is therefore absolutely natural and understandable that the eyes and the lips attract the attention more than any other part of the human face". (p. 191).

It is quite incredible that in a crowded shopping mall or football stadium, we can look at the faces of thousands of human beings and yet immediately recognise someone we know. Thousands of faces – yet in a flash (two or three photographs) we can identify the one which is familiar. Part of this ability must be based on selection of vitally important visual data.

Study of eye movements (fixation points) is likely to add greatly to our understanding of what visual data input is crucial to ongoing visual perception.

As just one potential situation – a person who only infrequently comes across people from a distinctly different racial group is likely to comment - "all people of that race look alike". It is likely that in this situation, once that person has received visual input identifying racial grouping, the person no longer takes in detailed information on eyes, nose, lips, hair etc. which he would normally use to distinguish individuals in his everyday world. This type of hypothesis will be readily testable by eye movement cameras.

Similarly, eye movement studies should yield very interesting data about selection of visual information in various situations, both momentarily and over time. For instance, we might have subjects connected to eye movement recording apparatus watching the same passing parade of a wide variety of people on a TV screen.

It is certain that there will be differences between men and women, between children, young adults and older people. Which people in the parade are picked out by which group, which people are ignored, how thoroughly are people of interest inspected, which features of them are inspected? When a man looks at a group of women, where does he look, where does he spend most time looking?

Other factors such as occupation, cultural background, emotional state are also very likely to influence ongoing selection. There is a huge area waiting to be studied, and the results should add significantly to our understanding.

7.3 Identifying the Brain Location of the Visual Field

There is already a huge body of knowledge about the neurophysiology of vision. What we are hoping for is to identify firing over a patterned area in the brain occurring at the exact moment of occurrence of the momentary visual experience, as defined. If this occurs, we can use descriptions of the momentary visual experience to identify processing of visual information which has occurred up to that point.

There will be methodological problems insofar as it is virtually certain that various areas of the brain need to work simultaneously, so there may be difficulties in identifying which particular area of activity is uniquely identical to the visual field experience. However, experimental ingenuity and a clear focus on the definition of the momentary visual experience should provide the basis for expansion of knowledge in this area.

Some textbooks present an implicit notion that, with "seeing", the brain (or the mind?) is "creating" some internal three-dimensional world which we look at.

Perhaps this does occur in a loose allegorical sense. However, the concept in this account is of a two-dimensional field in the brain with a constantly changing pattern of neural firing, so that one pattern merges into the next. The pattern for any momentary field is expected to be generally similar to the momentary snap-shot retinal image.

The notion is analogous to a two-dimensional movie screen in the brain, with the information guiding the ongoing visual perceptual process as well as enabling complex decisions about reacting to the outside world.

Without downgrading the incredible complexity of the brain as a biological computer, our search to find a two-dimensional patterned area of neural firing in the brain seems achievable in terms of our present physiological knowledge – as contrasted to a possible search for an area creating a three-dimensional scene with figure and ground.

The occurrence of the visual field experience might be expected to be identical with a neural pattern of firing at an "advanced" area of the brain. Regardless of whether we can identify this, the fact that we can <u>clearly describe</u> the momentary visual experience presents us with a tremendous research tool, to examine the relationship between the image falling on the retina and the way it has been processed at a particular level of the brain.

7.4 The On-going Sequence Being Seen as the Real World

We developed the notion at 2.3 that the ongoing sequence of visual fields is taken by us as <u>being the real world</u>, which we "look at" – not (as it really is) an ongoing movie sequence in our brain. As such it plays a vitally important role in orientating us to the real world.

This is a tremendously useful way to use visual consciousness, and its efficacy relies to a large extent on each momentary visual experience being an "evenly-graded" photograph merging seamlessly into the next.

Simultaneously, with this ongoing experience and almost always at an unconscious level, we are directing our eyes ("looking at things") to seek out more detailed information available in the field.

In complex fields we may not find the information we are seeking (camouflage), and in unusual situations we may come up with strange results (illusions, nonsense figures). But in 99% of situations, vision is an extraordinarily powerful tool allowing us to deal with the world.

CHAPTER 8

MEMORY AND THE VISUAL EXPERIENCE

8.1 Pictorial Memory

The visual experience can also be used as an object of study in the area of memory, (**although in this area, I am far less certain about what is going on).**

Close your eyes. Now "picture in your mind" say a famous painting – the Mona Lisa – or a famous person – say President Obama or Elvis Presley.

You are able to experience a "picture" which we will call a memory visual experience, describable in terms of a patterned coloured field.

With the visual experiences which occur when our eyes are open, the scientist can concentrate on studying the relationship between the physical patterns of light falling on the retina and the experienced visual fields. We can get valuable clues as to what is going on from an understanding of the physiological mechanisms of the eye and the eye muscles.

With the memory visual experience we do not have this assistance. One of our major tools is probably trying to relate the memory visual experience to the "waking" visual experience.

The potential reward from this study is some understanding of memory, learning and meaning (three concepts with broad overlapping of what they are referring to). When we "picture in our mind" the Mona Lisa, we seem to experience a single picture of the Mona Lisa which we see instantly as one picture, not an ongoing sequence which has taken time to assemble.

In this sense, the "memory visual experience" seems similar to the "evenly-graded photograph" visual experience.

Yet for me, while I have the picture of the Mona Lisa, it has nowhere near the vividness of colour of currently perceived visual fields.

8.2 Storage of Visual Information

Going back to our discussion of the "hidden picture" of the tiger, we initially experience a sequence of ongoing visual experiences which are relatively "meaningless", until we suddenly detect the detail which is crucial to identify the tiger. We can then go back to the picture ten minutes later, or maybe even a month later, and immediately "see" the tiger in almost the first glance.

Obviously information from the initial perception of the hidden picture has been stored, including crucial information to guide scanning by the eye muscles.

Some questions occur for which I have no immediate answers. Immediately after looking at the hidden picture and detecting the tiger, I believe we are able to close our eyes and "picture in our minds" the drawing. We can ask our subjects to describe this memory visual experience; it will be important to find out whether these descriptions are relatively similar or whether they vary widely between subjects. If there

are wide differences, can these be related back to differences in the way various individuals scan the original picture (highlighted by eye movement data)?

It was postulated earlier in this work that we experience a seamless ongoing sequence of visual fields. Is every one of these stored (and this would entail massive storage of information, making this suggestion seem unlikely)? In the case of the hidden picture, do we store any on the initial "nonsense" fields before we find the tiger? Or do we store "single pictures" of important objects? And when we "picture" these, is the visual field which we can recall as a memory visual experience occurring in the same spot in the brain as the momentary visual experience?

In the examples mentioned earlier- our "memory visual experience" of the Mona Lisa or President Obama or Elvis Presley – my initial guess is that we seem to be storing some sort of single composite snapshot. My reason for saying this is that we seem to be able to immediately see the whole memory visual experience – we do not seem to take several seconds to build the picture up. And it is a "single" not a moving picture.

Also, I personally seem to have only one particular snapshot of President Obama and Elvis Presley (although it would be surprising if one could not deliberately set out to memorize three different snapshots). With people very close and near and dear to me, I have difficulty calling up a memory visual experience at all, yet with acquaintances I rarely see, I can call up an instant snapshot.

Perhaps (and this is mere speculation) when we scan the hidden picture initially, we do not "store" (memorize) the visual experience. When we suddenly "see" the visual information, we then concentrate our eye movements taking a rapid series of snapshots focusing on key visual information.

Does this sequential "building up" lead to a single stored visual "picture", which we can recall as a visual memory experience if we try? A single built-up visual memory would be a far more efficient way of storing visual data than wholesale storage of every visual experience. It might also provide an efficient cornerstone for <u>recognition</u>. As we scan the crowd, how do we suddenly recognize one face as a face we have seen before? There is obviously <u>something</u> stored in our memory which allows recognition to occur.

While we are awake and our eyes are open, we are continually scanning our environment (with an incredible number of images being processed every day – and an incredible amount of information, if we were to try to store it).

When we detect an object of interest in our visual fields, we focus on scanning this object, so that the brain is now receiving an extended sequence of fields, often varying only slightly, and maximizing detailed information about this object of interest. Perhaps memory only occurs (whether in the "single picture" format or not) when there has been this concentrated sequence of fields.

There are huge opportunities for insightful research in this area. The concept of the memorized visual experience (whether this be a "single snapshot" or not) may give valuable clues as to the process.

There is obviously other memory attaching to visual field memory, for example, names of people. But then we often say "I remember your face but cannot recall your name" (or the other way around). And there may be masses of other stored information relating to the visual memory, with all sorts of potential behaviour reactions.

8.3 Memory and Ongoing Selection

With ongoing visual perception, learning is obviously vital to guide efficient ongoing selection of visual experiences. There are certain to be a huge collection of learned selection behaviours.

For example, do we have a set of "general visual scanning behaviours", appropriate to walking down the crowded street, perhaps taking in two or three snapshots per person? Do we switch to a different "recognition scanning behaviour" when we are introduced to a person whose face we wish to remember? Do we remember a "hidden picture scanning behaviour" to deal with the hidden picture, or do we remember a snapshot of the hidden picture with some identification or memory of the point to look at to identify and see the tiger? When we are driving a car, walking the dog, watching a movie, we have learned strategies operating at a subconscious level guiding our ongoing selection.

Is the "memory visual experience" occurring at the same location in the brain as the "momentary visual experience"? Experiments are sometimes done (with their permission) on patients conscious while undergoing brain surgery; alternatively, sophisticated machinery can detect patterns of brain activity. It well may be possible to locate a field of activity corresponding to the "memory visual experience", and it will be exciting to find out if this is the same location as the (waking) visual experience.

8.4 Dreaming

When we dream, visual experiences are part of what is going on. Considerable experimental ingenuity will be required to investigate the visual experience content of dreams. Subjects who have been dreaming will need to be woken and asked incisive questions.

For example, my initial reaction would be to guess that we have a smooth ongoing seamless visual experience, similar to waking visual perception. However, this seems to clash with the composite snapshot idea of the memory field. In any event, it would be most instructive to identify a brain location for those dreaming visual experiences.

A sleeping dog seems to be having dreams, which must be analogous to ours. There are stages when the dog's eyes can be seen moving beneath closed lids, giving the impression the dog is "looking at things". It is well documented that rapid eye movements occur during human dreaming. How do actual eye movements link in to the experienced dream?

CHAPTER 9

CONSCIOUS EXPERIENCE – EIGHT PROPOSITIONS

9.1 Introduction

In the preceding chapters, we have seen how visual experiences – conscious experiences – can be described in useful and meaningful ways, and indeed can be extremely powerful (essential?) tools in the study of visual perception.

There was some question as to whether ongoing visual experiences occurring when our eyes are open, memory visual experiences occurring when we picture something "in our minds eye", and dreaming visual experiences are the same or partially the same. Nevertheless, there are scientific methods available to investigate these questions and to increase our knowledge.

We discussed how the experienced visual field can be described as a two-dimensional field of patterned colours – just as the pattern appearing on the movie screen can. However, in our ordinary life, we would rarely take an interest in examining the content of the field two-dimensionally – we react to fields in an ongoing three-dimensional fashion, because this is vital to us.

We have learnt complex ways of reacting to ongoing visual experiences, not a small part of which is using present information plus learned responses to guide our ongoing visual data selection. We have learnt to attach labels such as "John Smith" to the face, or "danger" to the tiger no longer restricted by its cage. All of these constitute a particular usage of the word "meaning".

A central purpose of this short work is to use the lessons learned from examination of visual perceptual experience to offer some basic propositions about the nature of conscious experience.

9.2 Scientific Description of Visual Experience

Proposition #1. The uniquely visual conscious experiences which occur when our eyes are open (visual experiences) can be described scientifically.

What is essential is to be completely clear what we are talking about. The "visual experience" in this work is defined as the event which happens when our eyes being closed, the eyes are opened briefly and then closed again.

We have no difficulty in describing this event in terms of a coloured, patterned field. Moreover, if different people are given the same point in the environment to focus on, they will in general come up with very similar descriptions of the event that happened.

Exceptions to this, such as occur with colour blindness, can be detected scientifically and tend to fall into definable subgroups.

The important principle is – not only can we describe the conscious event that happens, but in general we will agree on a common description of the event which happens when a particular pattern of light falls on the two retinas, with our eyes fixed on a particular point.

The visual experience itself can be described in terms of a coloured and patterned two-dimensional field. It is hypothesized that three-dimensionality lies in meaning given to the field, rather than a quality

inherent in the visual event itself (in the same sense that a two-dimensional photograph takes on three-dimensional meaning).

9.3 The Notion of Privacy

Proposition #2. Visual experiences are events we are aware of, conscious of. While in one sense they are private, they can be described publicly and therefore scientifically studied.

In one sense of the word "privacy", my visual events are obviously private – only I can have (can experience) my own visual experiences. But if I can describe what goes on in me to you, and my description makes sense to you, they are no longer "private" in the sense of not being able to be described.

And if it happens that when the red triangle on the white background is flashed on the screen in the darkened room, and everyone present describes it in the same way except for those in the room who are blind or suffer from some unusual colour-blindness, it makes even less sense to say the visual experiences are private in some mysterious sense.

And in fact, as discussed earlier, if we are clear about what the visual experience is, and are careful about how we describe it, the study of visual experience becomes an extremely useful tool to investigate the visual perceptual process.

9.4 Identification with Brain Events

Proposition #3. Research will reveal that there is a unique area of the brain where a pattern of neural firing coincides exactly with the occurrence of the visual experience. This is an identity theory – the pattern of neural firing is the same event as the occurrence of the visual experience.

While this proposition is an "act of faith" at this stage, it would be an incredibly strange state of affairs if this does not turn out to be the case.

There is already a very considerable body of work investigating brain physiology function. In some experiments, the exposed brains of people undergoing brain surgery while conscious are stimulated, and they describe what they see. The limitation has been on clearly defining what "seeing" response or experience is involved.

While such experiments have already provided much knowledge about how pathways in the brain process information, retrieve memory and perform other functions, it is likely that clear identification of the sites identical with particular conscious experiences could significantly advance our knowledge.

There is discussion in the next chapter at 10.4 of the philosophical question of whether there is some fundamental quality of consciousness which science cannot explain or study.

9.5 A Unique Experience for each Sensory Modality

Proposition #4. There is a unique type of conscious experience associated with each of our senses, which can be described and studied in the same fashion as the visual experience.

The earlier chapters were spent discussing the conscious experiences associated with vision. The question was left open as to whether the visual experience, the memory visual experience, and the dreaming visual experience are identical – they might or might not occur at the exact same location in the brain.

However, all three are uniquely visual in being able to be described in terms of a two-dimensional coloured patterned field, and all three are conscious events – we are aware of them happening.

It is proposed that a similar analysis can be made for each of the human senses, and that for each of these there will be a unique type of conscious experience.

Let us consider the auditory experience and an appropriate way to study this. We might have ten people sitting in a blacked-out room, looking at a yellow focal point on a screen. We momentarily flash a red point on the screen next to the yellow, at the same moment as we tap a wine glass with a spoon.

The room is black, so the subjects cannot see what has happened. The subjects are asked, "Did you have an auditory experience at the same moment as the red point flashed on the screen?"

I am certain that they will all say yes (with the possible exception of defined sub-groups such as deaf people). We might ask them to describe the sound – some might say it sounded like a "ting", others might say it sounded like a spoon hitting a glass.

However, to be certain they all had a very similar experience, we might ask them to make a noise as close as possible to what they heard. It is hypothesized they will all make virtually identical "ting" noises.

Once again, this type of definition seems so simple, it is almost trite. But it is essential to clearly define the auditory experience – it is a conscious event which occurs, it sounds like a "ting".

In a parallel fashion to our earlier discussion of visual perception, the study of hearing should clearly take into account and use the auditory experience. Once again, we seem to project the "thing" as being out there in the real world , originating in the real world. The bark is "coming from" the dog – we are not thinking about it as being in our head. It is part of the real world. A question - how does the blind-from-birth person picture the "real world"?

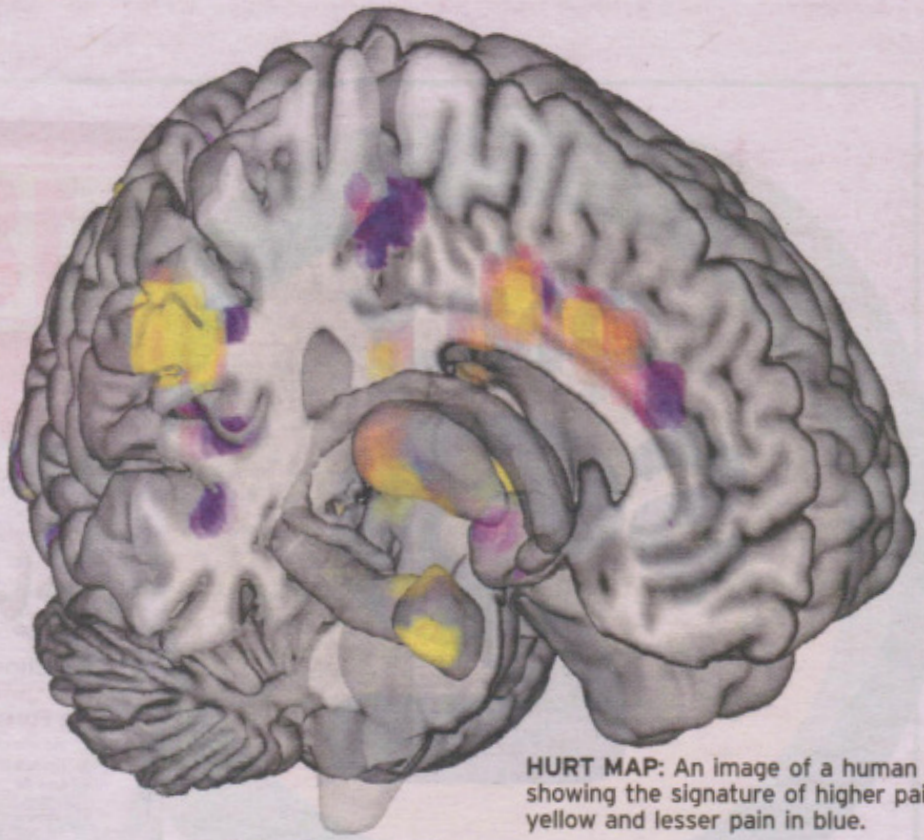
Scientific analysis is likely to be easier for the outward–looking senses – vision, hearing, smell, taste, touch, heat and cold. The relevant sensory receptors are located in external locations of the body, and the conscious experiences can be linked to relevant stimulation provided by the environment.

Figure 21 is a newspaper extract illustrating how scientists are increasingly able to match particular experiences with patterns of brain activity (in this case pain). It also in a very preliminary way illustrates how we may be able to separate out actual experienced pain (from heat, cold, sharp etc.) from more "metaphorical" pain - the pain of romantic breakup.

The analysis of conscious experience is likely to be far more difficult and less clear-cut for sensations coming from within, and might well be the subject of considerable ongoing debate.

For example, we have body position sensors which have associated conscious experiences. To examine these, it often helps to close the eyes, to block out the visual experiences which seem to have a dominating effect on what we are aware of. With your eyes closed, concentrate on the sensation of your bottom sitting on the seat, your elbow resting on the table, your neck holding your head in a particular position.

There are conscious experiences associated with these – specific sensations of which we can be aware. However, it would seem for the large part of our waking life we are not aware of them – I am only aware of the feeling of my bottom pressing on the seat when I focus attention on it, and in ordinary life, I may only do this when I have been sitting on a hard seat for a long time.



HURT MAP: An image of a human brain showing the signature of higher pain in yellow and lesser pain in blue.

Science reveals the 'ow' factor

SCIENTISTS say they have figured out how to recognise pain in brain scans, possibly paving the way for tests that could gauge severity.

"There's no clinically acceptable way to measure pain and other emotions other than to ask a person how they feel," said Tor Wager, lead author of the paper, published in the *New England Journal of Medicine* this week.

For the study, magnetic resonance imaging scans were performed on 114 volunteers as heat, ranging from warm to hot, was applied to a forearm.

Researchers thought they would find a unique pain signature in each individual, since some are more sensitive than others.

But they found the brain signals discovered were transferable across different people, allowing scientists to accurately predict pain levels.

Participants who had been through a recent romantic breakup were shown an image of their former partner.

Although past studies have suggested spurned lovers experience a pain similar to physical pain, this study found that the heat-pain signature was absent in lovelorn people.

Agence France-Presse

Figure 21. Neural Patterns and Pain

Obviously the body is vitally dependent on this body-location information, but almost all of the time processes the data at a sub-conscious level.

There are more obscure sensations – stomach-sickness sensations, sensations associated with excitement, orgasmic thrill sensations.

The task is to subject these to rigorous analysis, separating a description of the actual sensory experiences from more complex words which overlay additional meaning onto the actual event. The danger is reification – assuming that because we have a word, there must be some separate thing or event which exists and corresponds to that word.

Take for example the word "fear". Do we have a separate fear sensation – or does fear describe a combination of more basic sensations such as a sensation of "adrenalin rush", a sensation of heightened muscular tension or preparedness, and heightened preparedness of vital senses (perhaps vision or hearing or smell, or all of these)?

This is only a very tentative discussion of fear – the point being made is that, when we are concentrating on defining the basic conscious experiences forming the building blocks of our conscious life, we must be very cautious. For example, we must not assume that for every emotion word there is another different sensation (such as the "pain" of romantic breakup).

9.6 Defining the Fabric of Consciousness

Proposition #5. Our conscious world (in terms of the actual events we experience, the actual events which occur) is limited to the range of sensory-linked experiences.

Sceptics are likely to say that we have more complex experiences – feelings of power, the experience of self, feelings of love, thoughts.

Is "thinking" a conscious experience? Or is the word a generalized concept describing events happening over time, linked sometimes to memory experiences (visual, auditory, etc.) and describing the process by which our brain applies learnt methods to come up with appropriate problem-solving behavior? Beware of reification – because there is a useful word, there does not have to be a corresponding existing thing.

This proposition is hypothesizing that there are no conscious experiences occurring at any moment, apart from those which are sensory-linked. The words "power", "self-identity", "love" and "thoughts" are obviously very useful, but do they involve experiencing at any given moment some type of conscious awareness different to the sensory linked experiences?

Consideration of #5 links in with #6, and will be further discussed in the context of #6.

9.7 The Unique Role of Conscious Experiences

Proposition #6. Conscious experiences (events) have unique characteristics giving them a special role in brain functioning.

There are a number of points requiring discussion, many of which revert back to the question "What is consciousness?"

a) In one sense, "being conscious of" is simply the event occurring.

If I say, "I am aware of the visual experience", is this saying any more than, "The visual experience is occurring"?

The first expression suggest that it needs an "I" to be aware of the conscious event. The second expression says that while it is fine to talk about "I being conscious of", at this level "consciousness" is simply the event occurring. The "I being aware of" adds no new meaning to the actual occurrence of the event. There is no "I", no homunculus, no man sitting in the theatre watching the movie and deciding which aspect of the movie he is going to look at.

b) Contrast to "unconscious".

Our body is continuously functioning, keeping our heart beating, food processing, breathing oxygen etc. All of these events are continually occurring without our being aware of particular sensations – except in very unusual situations when our heart races, or our lungs seem ready to burst if we try holding our breath underwater.

From a functioning point of view, these systems seem to work perfectly in a more or less "automatic" fashion. They do not require "conscious input", "conscious decision-making", to function efficiently. People whose brains have been badly damaged and are in a coma, can often keep breathing, digesting food and circulating blood for many years.

c) Conscious experiences play a unique role in our ongoing existence.

Firstly, our conscious experiences become "the the real world", allowing us to orient ourselves incredibly quickly to the objects and events surrounding us - not just their physical position, but myriad qualities of these objects such as hardness, taste, beauty, movement.

Just image trying to program a robot with this ability - an impossible task with our present level of technology.

Secondly, we are able to manipulate and examine conscious events in unique ways. In contrast to events happening at the unconscious level, where reactions seem to occur in an automatic servo-mechanism fashion, conscious events are able to be prolonged, to be examined in more detail, and choices made about suitable reactions.

I have been given instructions to look for the tiger in the hidden picture. As a result my eyes scan the picture for as long as it takes. Suddenly I am aware of the tiger – the visual experiences occurring which provide recognition of the tiger.

There is this characteristic of being able to examine the conscious field, to deliberate about it in order to select an appropriate response.

There is a tendency to consider this in terms of an "I", a "me", who is scrutinizing the visual experiences and making decisions. In turn, this leads to a notion of a conscious "self", a god in the machine who is dealing with the data of consciousness, a "self" which exists independently of the brain.

If we can substitute the term "my brain" for "I", and in doing this what we are saying makes the same sense, we may distance ourselves from an "I" existing on a separate plane of being. "My brain received instructions to look for the tiger, my brain gave out ongoing instructions to my eyes to scan the picture, and when the tiger information was available in more in detail in the central field, my brain recognized it as a tiger". Describing the events in this way makes the notion of an "independently existing self" less meaningful.

Most of our waking hours seem to be spent in a state of consciousness – of continually experiencing conscious events. We use these ongoing experiences (especially visual experiences) to stay orientated to the "real world", and to guuide our ongoing reactions to our physical environment. Is there something special about consciousness over and above this - or is this ability special enough?

d) Conscious events provide access to a wide range of behaviour choices.

As contrasted to the relatively automatic and stereotyped reactions to non-conscious stimuli, we seem to have a wide range of "voluntary choices" available when the conscious event occurs.

The occurrence of these conscious events seems to be a precursor to much of our learned, more complex "voluntary"behaviour (as contrasted to "involuntary" behaviour).

Conscious experiences seem essential for detailed analysis preceding difficult decisions. They seem to have a key role in analyzing complex situations, and in delaying reactions until the most appropriate behaviour is selected (the difference between "voluntary" and "involuntary" reactions).

We are coming here into the realm of "thought" and the use of language - extremely complex processes outside the scope of the present account.

e) Storage of Complex Information

It is problimatic (and unlikely because of the sheer magnitude of this information) that all of the data providing ongoing conscious experiencer is stored in memory.

In the case of vision, an analysis using eye movement camera technology will let the scientist pin down the sequence of visual fields being selected, and in this way identify the sequence of detailed information falling in the central foveal field. One would expect that this in turn will provide valuable insight into information being stored in memory, and what is required for identification of objects.

9.8 Ongoing Selection of Conscious Experience

Proposition #7. For most of our waking life, we are in a state of ongoing data analysis. Previous learning plays a crucial role in determining our ongoing selection of conscious experiences.

This sounds very obvious and rather trite, because otherwise our data selection would be more or less random.

Perhaps random sensory input happens to some degree the case with the newborn – certainly we expect the growing child through learning to become progressively more efficient in guiding the selection of ongoing information.

When we talk about learned responses, we probably think first of the things we say and do – the more obvious external responses. What is being emphasized here is the crucial role of continuous ongoing information selection, mirrored in our ongoing conscious experience.

In the case of our hidden picture, we may have taken three minutes to first find the tiger. Once we have learnt its location in the picture, the next time we look, we can find the tiger in less than a second.

It is very important to realize that every second of our conscious experience is being guided by a combination of the previous second's experience plus learning. In turn, the experiences of this second will be an important basis of what will occur next.

9.9 Focusing of Conscious Experience

Proposition #8. As part of the ongoing selection process, we are able to focus on the most relevant sensory modalities to the partial or full exclusion of others.

This "focusing" is reflected in the conscious experiences we are aware of, and examination of conscious experience can further our knowledge in this area.

As mentioned earlier, the experience of our bottom pressing on the seat will tend to occur rarely and only when we focus our attention on that sensation. In contrast, the ongoing visual experience seems to have a pre-eminent role in our ongoing conscious experience, almost certainly because it is such an incredibly efficient way of staying in touch with the real world around us.

We might shut the visual fields off by closing our eyes, if we wish to concentrate on listening for particular sounds. This seems to enhance the auditory experience, and allow more detailed analysis of the auditory event. Closing the eyes can also help focus on other sensations, such as the sensation of our bottom pressing on the seat. Pain at the dentist is enhanced if you shut your eyes, lessened if you can look at interesting things.

There also seems to be an ability to shut off conscious experience <u>within</u> a particular modality. I suffer from tinnitus – ringing in the ears. However, I rarely hear the ringing (experience the sensation) until the word "tinnitus" is mentioned. I can then hear the ringing very clearly; the ringing sound gradually recedes from my consciousness, and I do not hear it again usually until the next time I hear the word.

CHAPTER 10

SOME GENERAL CONSIDERATIONS

10.1 Are other animals conscious?

In terms of the conceptual framework outlined in this work, our actual conscious experiences occurring at any moment of time are a complex set of experiences corresponding to (and limited to) our sensory modalities.

In general, visual experience and auditory experience dominate the consciousness of man. Less well-documented inner sensory experiences provide an emotional dimension to the more prominent experiences linking us to the external world.

With this conceptual approach, it would seem extremely strange if the higher apes do not have conscious experiences similar to ours.

For a start, their brains have many similarities to ours. If we can conclusively identify the area of activity in the brain corresponding to the momentary visual field, and chimpanzees have similar brain areas where activity occurs, it would be logical to surmise that chimpanzees have similar (though not necessarily identical) conscious experiences.

Moreover, from general observation, chimpanzees seem to scan the environment in ways similar to humans, they seem able to manipulate the sequence of information in a problem-solving way, they seem able to dream (with the implication of recalling memory experiences).

Are chimpanzees' visual experiences identical to ours? This is a question completely open to scientific testing. Are the visual paths and visual areas of the brain identical to ours physiologically, or are there significant differences?

Do they see the colour "red" identically to ourselves? This is testable scientifically, using the same techniques science has used to discover that certain sub-groups of people are red-green colour blind. (And note – red-green colour blindness has an inherited genetic basis, linking in to our identity theory of a brain event identical to the conscious experience. Is genetic colour-blindness due to differences in the visual sensory input being transmitted to the higher area of the brain, or is there a qualitative difference in the brain area the site of the visual experience?)

It would seem likely that animals lower down the evolutionary scale, such as dogs and cats, also have visual and auditory experiences. And it is most likely (and testable) that these experiences are qualitatively different to ours, perhaps in some aspects less information-rich and in other aspects more complex than ours. And senses such as taste and smell are certainly more highly developed in some animals.

Is there a stage in this phylogenetic ladder when the organism is no longer having conscious experiences? It might be suggested that this is the case where the organism always reacts in a more-or-less automatic way to environmental stimuli, albeit that learning may alter the reactions over time.

As we elaborate more thoroughly the special attributes of conscious experience (as discussed at Proposition 6 in the preceding chapter), we may be able to pinpoint more specifically changes in the continuum of brain functioning.

It has often been assumed that man in set apart from other animals by possessing a "conscious mind". This account suggests that it is virtually certain that higher animals have conscious experiences (as we have defined them), so man is not set apart by this feature. What sets man apart is his ability to store the information he has received, to use language to communicate knowledge, and to manipulate the environment using this stored knowledge. The human brain is an incredibly complex and efficient "organic" computer.

10.2 What is "thinking"?

Thinking is a complex area in which I have little expertise. However, the conceptual framework of defining conscious experience may provide useful tools to study aspects of thinking.

The word "thinking" is without doubt a polymorphous concept, not a word standing for a unitary thing. With most usages there is reference to process, a sequence of actions leading to particular behaviours.

The philosopher Wittgenstein discussed how the word "game" can be used in different ways in different context, without having a single definition applying to all games. There are groups of games with similarities, and similarities between groups, but no one single definition. In spite of this, we have no difficulty using the word "game" and we find it useful to do so.

This ability to generalize offers an enormously powerful tool for memorizing data. It seems to set off the human brain against computers, which can store huge amounts of information and manipulate data at high speeds, but which rely on unitary definitions for processing.

In particular, this "generalization" (ability to pick out common features in diverse situations and store this under a common label) would seem a <u>key</u> feature of thinking.

It would seem likely that this ability to generalize is present in other animals, but not to the levels of complexity obvious in man.

Thinking is a fascinating area of study. Perhaps the present work can be of assistance in helping to be clear about conscious experience which may (or may not?) be part of thinking. And study of "memory experiences" may contribute to knowledge of what information is stored, and whether such memory experiences are part of the thinking process.

10.3 Does man have a "mind"?

It has long been accepted that man exists on a different level to all other life on the planet. This special "something extra" possessed only by man is often proposed to be a "mind".

This account proposes that the only mental events which occur at any one moment of time are experiences connected to the various sensory modalities.

Man is able to use, select and manipulate these experiences in enormously complex ways. As monument to this, man has been able to change and modify his environment in deliberate ways, on a scale of complexity a quantum leap greater than all other living organisms.

Does this signify that man possesses some <u>extra</u> attribute (perhaps a "mind"), of far greater complexity than any other animal? Or (more simply), is it that man's brain has evolved with the ability to store far more

complex information, and thus use learning in far more complex ways, coupled to such physical attributes as agility and opposing thumb-finger movement allowing manipulation of physical objects?

Earlier we discussed the danger of "reification" – of assuming that, because we have a word, there must exist some "thing" corresponding to that word. This is not in any way to deny the usefulness of words conveying complex meanings, but to caution against creating "additional" existing things and also to caution that particular words might have quite different meanings (uses) in different contexts without detracting from their usefulness.

Just because we have a useful word, "mind", we must be careful not to automatically assume there exists a separate thing corresponding to the word. We must examine the use of the word in different contexts to understand what is being discussed.

In a recent article discussing mind and body dualism, reference was made to differing areas of the brain being active during introspection (reflecting on one's own state) and visual recognition of one's own face. There seemed an inference that these might identity location (or locations) of the mind.

This account suggests that, to understand "the mind", we need to understand not only the fabric of consciousness (the conscious events which occur), but also the many and varied behaviours which together come under the umbrella of this word.

There will not be any sudden illumination of what "the mind" is – rather the gradual accumulation of knowledge about events and behaviours all contributing to understanding of varying situations to which the words "the mind" refers.

Are there special features other than a greater ability for complex learning which place man in a different sphere to other animals? Perhaps family values – but certain other animals have strong family commitments, and some do bond for life. Perhaps an enjoyment of life – but dolphins seem to enjoy surfing a wave, and pigs seem to enjoy wallowing in mud. Perhaps a sense of right and wrong – but often people will debate what really is right and wrong.

It is possibly part of man's sense of superiority that he wishes to have some special quality setting him on a higher plane than all other forms of life – instead of being content with being the possessor of an incredibly complex biological computer, able to acquire centuries of accumulated knowledge and capable of performing extraordinary feats.

10.4 Is there some fundamental quality of consciousness which science cannot explain or study?

Philosophers have asked – why should a pattern of neural firing feel like anything? Why does the red triangle appear red, why does the tapped wineglass sound like "ting"?

Why are these so different to an experience of pain, or an orgasmic thrill, if they are all simply patterns of neural firing in different places in the brain? Why do they seem so hugely qualitatively different?

Some writers have argued that consciousness is an "emergent property" of active networks of neurons – something "extra" not found in the neurons themselves. There are rather strange theories about "quantum states" producing consciousness, and mathematical explanations involving synchronous oscillating brain waves. And in any case, these do not seem to address the question of "qualitative difference".

We have set out how science can study the momentary visual experience and the sequence of visual experiences. We have defined the situation in which the momentary visual experience occurs, we can describe it in virtually identical ways, and presumably neurophysiologists will identify the neural correlate of the momentary visual experience. Similarly with the momentary auditory experience – except that we will be using different words to describe it.

Scientific study of vision in the past has been hampered by a lack of clarity about the events being studied. This treatise gives a clear definition of the "experienced" content of seeing, which should help clarify present knowledge and stimulate ongoing research.

Similarly, clear definitions and descriptions of the other sensory experiences will also further scientific knowledge. The broad propositions about consciousness outlined in the last chapter are testable by science, and the body of knowledge should be steadily expanded.

However, you still may wish to ask – if each of the sensory experiences (e.g. visual, auditory, pain, orgasm) is identical to neural firing at a unique brain location (Proposition #3), why are they qualitatively so completely distinctive?

This work is saying that science can thoroughly describe the various sensory experiences, especially by linking them precisely to the physical events stimulating the senses. In this way, we can study the sawfish's "electrical" sensory organ, and hypothesize it leads to a special sensory experience in the sawfish.

While we will never know what it is like to have the sawfish's "electrical" sensory experience (just as the person blind-from-birth may never know what it is like to have a visual experience), we can still scientifically study and understand the sawfish experience – just as the blind-from-birth person can know about and understand visual experience.

Obviously I will know more about the conscious experiences I actually have, compared to the ones I don't have (e.g. the sawfish electrical experience), but only in the sense of having these particular experiences. But this does not make my experiences mystical or "out of body" or unable to be studied – the only difference is knowing how these experiences "feel". All conscious experiences, including one's you or I don't have, are able to be described and studied scientifically.

And as to why firing at different neural locations can be as different as visual, auditory, pain and orgasm experiences – we come back to the same metaphysical question that might be asked in physical science – why do gold and silver and oxygen exist at all, why are they so different?

The scientist's answer is simply – this is the way things are. Science will examine and describe things and their relationships, without answering (or needing to answer) – why do these laws of science exist? Why didn't things happen differently?

The question is akin to asking – why is sodium so different to oxygen? Why are solids so different to gases? The answer is simply – they are that way. By describing sodium and oxygen and solids and gases thoroughly, and how they interact, science gives us understanding without trying to answer the metaphysical question – why are they so different?

As science progressed, groupings in molecular structure were discovered which helped us understand similarities between metallic elements. Gold and silver are relatively more alike (have more similarities) than they are to another element, oxygen. But at the end of the day, we can still ask the question – Why is gold so fundamentally different to silver? Why should gold exist at all?

Science is content to say that it has done its job in describing the elements, and how they react and take their place in the scheme of things. You might ask the scientist - why is gold so different to silver? why should gold exist at all? why should gold be more rare than silver? The scientist would shrug his shoulders and say – I've done my job by describing the elements and studying how they interact. This body of knowledge gives some partial answers to your questions, some reasons for example to understand the differing properties of metals. But having said this, I don't have any answer for what I would term your metaphysical questions, and I don't need such answers to deal with gold and silver in the real world.

CHAPTER 11

SO – WHAT ARE YOU?

11.1. What is the Problem?

In 2004 the "New Scientist" listed "what is consciousness" as one of the ten most important unanswered questions about the living world.

The article stated - *"It is easy to describe what consciousness feels like. It is all about being awake and aware, having a sense of self and a feeling of embodiment, of knowing the difference between you and the world around you. It also is about having a history or narrative made up of a continuous flow of thoughts, images and sounds – your stream of consciousness. Most importantly it is about how it feels to be you.*

But herein lies the problem. Consciousness is a really difficult question for science, because it is entirely subjective. That is why the study of consciousness has long belonged in the realms of philosophy and religion".

The following sections will examine phrases out of this statement of the problem, discuss how this account deals with them, and in particular relate them to eight general propositions about consciousness set out in Chapter 9.

11.2 Is the Study of Consciousness "Entirely Subjective"?

Our account has dealt with the notion of privacy. By clearly describing the momentary visual experience, we can find whether this experience is described in identical terms by different people looking at the same object (i.e. with the same patterns of light falling on their retinas).

This does occur – and in this way science can study the sequence of momentary visual experiences and how these relate to the "seen" physical world. So this study is by no means "entirely subjective", provided we are clear about what we are studying.

This account went on in Chapter 10 to offer eight propositions about conscious experience, all of which can be examined scientifically. Understood in this way, it makes sense to assume that other animals also have conscious experiences relating to sensory inputs.

The notion of privacy is partly correct – we cannot have the experience the animals are having, so in the this sense we cannot know what the experiences are like. We cannot have the electrical experience of the sawfish. But we can still study the sawfish's experiences, scientifically relating these to the outside world, so in this sense they are not "entirely subjective". In short, privacy does not preclude scientific understanding.

Proposition # 2. Visual experiences are events we are aware of, conscious of. While in one sense they are private, they can be described publicly and therefore scientifically studied.

11.3 "Being Awake and Aware"

This account basically relies on being clear about the "fabric of consciousness" - clearly defining the conscious events occurring at a particular moment of time.

Chapter 2 had a very simple but crucial definition of the momentary visual field – the conscious experience corresponding to having the eyes open.

Proposition # 1. The uniquely visual conscious experiences which occur when our eyes are open (visual experiences) can be described scientifically.

What we experience can be described in terms of a sequence of "photographic" scenes. In an experimental situation, we can study what is involved in each momentary event.

Each scene is experienced as an "evenly-graded photograph", which merges seamlessly into the next.

Crucially, we do not consider these a "movie" going on in our head, a "brain movie". Instead, the sequence of experiences <u>becomes</u> the real world; stationary objects are out there fixed in space (not changing in position as they are on the movie screen) and our concept of this is that we are "looking at" different aspects of this relatively fixed "real world". They have colour, they have size and shape, they may make noises.

This is an incredibly useful tool allowing us to continually interact with our environment. Vital to this process is that the momentary experience appears as an "evenly-graded photograph", allowing the sequential merging of these events to become a seamless "movie".

However, scientific study has shown that when an object appears at the very centre of the visual field, we are able to, even though the momentary experiences appear evenly graded, distinguish that object in far greater detail, and make far finer judgments about exact gradation s of colour. While the book does not appear to change, in a test situation you will not be able to read the title on the book's cover unless the book is quite close to your central field.

This perception of fine detail and fine gradations of colour is essential to many aspects of our ongoing behaviour – reading and writing, distinguishing and identifying other people, preparing and eating food. Try doing any of these while looking 20^0 to the right of where you would normally be looking.

We are making use of this vitally important detail information through ongoing selection of visual fields, using a vast storehouse of learning to guide movement of our eyes. Rarely will this ongoing selection be random; almost always it will be closely geared to the highest priority task we are undertaking.

Almost always this will be undertaken without conscious deliberation. When asked, we will describe our smooth ongoing visual experiences as "seeing the world", although perhaps we might note that we are "looking at certain things in the world".

This account went on to suggest that there is a unique experience for each sensory modality.

Proposition #4. There is a <u>unique</u> type of conscious experience associated with <u>each of our senses</u>, which can be described and studied in the same fashion as the visual experience.

This account also hypothesized that science will identify unique areas of neural firing in the brain identical to the various sensory experiences.

Proposition # 3. Research will reveal that there is a unique area of the brain where a pattern of neural firing coincides exactly with the occurrence of the visual experience. This is an identity theory – the pattern of neural firing is the same event as the occurrence of the visual experience.

A further hypotheses proposed a limitation to the actual conscious events which occur (the fabric of consciousness).

Proposition # 5. Our conscious world (in terms of the actual events we experience, the actual events which occur) is limited to the range of sensory-linked experiences.

While there are words which we often use and which discuss complex "experiences" - feelings of power, love, thoughts, experiences – there is the caution that because of reification, we do not automatically assume we have discovered a "different" actual experience.

We have hypothesized that there are no conscious experiences happening at any moment (the fabric of consciousness) apart from those that are sensory linked. The complication to this assertion is trying to understand the "memory experiences" allied to each of the sensory modalities.

11.4 "Your Stream of Consciousness"

This account started with identification and clear description of the momentary visual field, but then went on to examine the ongoing sequence of these. While our ongoing visual experience seems a smooth and simple ongoing process of "seeing the world", what is actually happening is an extraordinarily complex data selection process.

Our eyes are taking three snapshots of the world every second, selecting visual information crucial to our ongoing functioning. Because of the seamless merging of the sequential visual fields, we have little awareness of the complex underlying activity.

For most sighted people, it would seem that conscious visual experience dominates their ongoing stream of consciousness because of its importance in orienting them to the real world and in dealing with the real world. While we are able to simultaneously experience conscious events corresponding to the other senses, we tend to suppress (i.e. to not experience) these unless they are relevant to the immediately pressing task.

And because for sighted people, visual information provides the most relevant data for the greater part of their waking life (as compared to the information provided by sound, smell, taste and touch), visual experience dominates their ongoing stream of consciousness.

11.5 "A Feeling of Embodiment"

This account went on to discuss some unique characteristics of conscious events. Obviously the majority of our bodily functions keep operating without conscious experience– our heart keeps pumping, our lungs keep breathing, our body remains balanced. But most of this is happening at an automatic, unconscious level, using feedback information of which we are rarely conscious.

An interesting point – we seem to retain very little record on what has happened at this level in memory. This might be expected – what would be the benefit of remembering these events?

Our account went on to make some general observations about conscious events.

Proposition #6. Conscious experiences (events) have unique characteristics giving them a special role in brain functioning.

What seems a crucial characteristic of conscious experiences is that in an important way, they do not require an immediate and automatic reaction. They seem to allow a process of detailed data analysis, possibly involving different sensory modalities and drawing on stored memory, allowing a delay in reactions until the most appropriate behaviour is selected. In this way they are a vital part of "voluntary" behaviour.

Also, it is the result of this complex analysis of data that is importantly stored in memory, to guide future action.

There were two further propositions discussing the role of conscious experience.

Proposition #7. For most of our waking life, we are in a state of ongoing data analysis. Previous learning plays a crucial role in determining our ongoing selection of conscious experiences.

As an example of these, the example of the tiger hidden in the picture was discussed. While initially it may have taken minutes to find the tiger, we then store the result to guide ongoing selection. Next time, the tiger can be found in a second.

Proposition #8. As part of the ongoing selection process, we are able to focus on the most relevant sensory modalities to the partial or full exclusion of others.

This ability to focus is an obvious advantage in ongoing selection of the most important data.

11.6 "Knowing the Difference Between You and the World Around You"

I believe that most of us in fact conceptualize the seamless ongoing sequence of visual fields as actually <u>being</u> the real world, which we are "looking at". This is an eminently useful, functional way to conceptualize the real world; it is a great way of positioning ourselves relative to the objects around us in the real physical world.

However, for the purpose of our account, we need to be clear that the momentary visual experiences which occur (go back to our definition at 2.1) are <u>not</u> the real world – they stop happening when our eyes are closed, they have colours such as red and yellow which are not inherent (except metaphorically) in the objects being perceived.

Similarly, we conceptualize the sound of the police siren or the noisy motorbike as being "out there" - we are not thinking of these auditory experiences being in our head.

But this works well in positioning ourselves spatially relative to the real world, to detecting important aspects of other things out there, and reacting accordingly. It would be completely unnecessary in every day life to think "How does this visual field (or this sound) in my head relate to the real world out there?" It would be a severe handicap to quick and efficient data processing.

The thought is echoed by Paul Bach-y-Rita. *"We see with our brains, not with our eyes". When a blind man uses a cane, he sweeps it back and forth, and has only one point, the tip, feeding him information through the skin receptors in the hand. Yet this sweeping allows him to sort out where the doorjamb is, or the chair, or distinguish a foot when he hits it, because it will give a little. Then he uses this information to guide himself to the chair to sit down. Though his hand sensors are where he gets the information and where the cane "interfaces" with him, what he subjectively perceives is not the cane's pressure on his hand but the layout of the room: chairs, walls, feet, the three-dimensional space. The actual receptor surface in the hand becomes merely a relay for information, a data port. The receptor surface loses its identity in the process.*

Bach-y-Rita determined that skin and its touch receptors could substitute for a retina, because both the skin and the retina are two-dimensional sheets, covered with sensory receptors, that allow a "picture" to form on them." (Norman Doidge, "The Brain That Changes Itself", pp15-16).

We have a more enigmatic situation with dreams. While dreams are occurring, we react as if it is a real world situation. When we awake, we are able to judge (often with relief) that it was just a dream.

11.7 "Having a Sense of Self and How it Feels to be You"

This account is hypothesizing that the fabric of consciousness – the actual events which occur – are all events linked to our senses or memory experiences of these. In this sense, these are our stream of consciousness.

While the expression "a sense of self" is useful, this account says that it is not a separate conscious event with a specific brain location. Rather, it is a useful term to describe the continuity of conscious events, the vast amount of stored memory available to be applied to these, and the ongoing cohesive behaviour resulting. It is the combination of all of these which can be referred to as "a sense of self". And bear in mind this is a generalized concept, like the words "game" and "seeing" - in each usage we may not be referring to exactly the same events.

What this account wishes to avoid is the notion of an "I", somehow existing separately to these events and memories and behaviours.

While we can talk about an "I" looking at the visual fields in an allegorical way, what is actually being experienced is simply a sequence of fields selected by eye muscles guided at an unconscious level by a vast amount of prior learning.

In this sense, the "I" looking for relevant information is my store of learned scanning behaviour, but not an extra entity sitting on a lounge chair viewing a TV screen. There is not a separately conscious "I" deliberately selecting the next move; this selection of the next move is taking place at breakneck speed, almost always at an unconscious level.

Similarly, "how it feels to be you" is another generalized concept – not a reference to a separate special feeling. In varying contexts it may be referring to different conscious events, different memories, different behaviours, though all with common underlying threads in the same way that all games have underlying links.

11.8 "Belonging in the Realms of Philosophy and Religion"

This account has argued strongly that conscious experience can be studied scientifically, and provide very useful knowledge to understand human and animal functioning.

The notion of privacy has acted as a barrier to the scientific study of consciousness. To paraphrase Wittgenstein, we need to show the fly the way to get out of the bottle – to understand how language works, and get ourselves out of difficulties created by words.

One problem is that the notion of something so private and different that it cannot be studied and understood, appeals to metaphysical notions of an incandescent spirit or soul, existing in some strange way independent of the real physical world.

While there is an element of truth in the notion of privacy – we cannot have the "electric experience" of the sawfish, and in this sense only we will never know what it is like – we can study scientifically how this sense works in the sawfish, and in this way understand it well.

You might ask – because you don't know what the "electric experience" of the sawfish is like, insofar as you cannot have it, why do you want to talk about it as a conscious experience?

The reason for this relates to the eight propositions about conscious experience put forward in this account. In terms of these propositions, it seems likely that the sawfish is having a conscious experience; this is testable in terms of these propositions if the "electric experience" can be shown to correspond to neural firing in an advanced area of the brain analogous to neural firing for vision and sound experiences

Assuming the sawfish has "electric experiences" would then confer on these the general properties of conscious experiences put forward in the eight propositions.

This account postulates that all of our conscious events will be able to be linked to brain events – an identity theory of mind. It does not see the need to postulate an "I" existing independently of these events – no eternal soul, no spirit to be reincarnated. This has implications for many religions which rely on such notions.

It is hoped that this account (focused primarily on what is going on when you have visual experiences) provides valuable insights into what is experienced when you see the world. This then leads to hypotheses about other conscious events – the fabric of consciousness.

The operational definition in Chapter 2 of a momentary visual experience is so simple it appears trite, yet it is the key to nail down "what is the conscious experience that occurs". From this we develop the notion of an ongoing seamless merging of visual experiences which for you "becomes" the real world.

Science depends so critically on having the appropriate concepts to make sense of what is being studied. Ancient civilizations of Greece, India and China all had the idea that everything was made from four "elements" – air, water, fire and earth. It was only when science developed the concept of atoms as basic building blocks of matter, combining into compounds, that knowledge of chemistry and the make-up of matter exploded.

Darwin's theory of evolution is a wonderful example of how a simple concept – "survival of the fittest" – helps us make sense of the composition of living species now and in the past. In a very simple way, it

encapsulates understanding of the reasons for the huge variations over time in the composition of species living on our planet.

One of the marks of such a great advance in knowledge is that once we have it, it seems so blindingly obvious – how could it be any other way?

I argue that we can scientifically study the conscious events which occur (the "fabric" of consciousness) if we clearly define what these are. My eight propositions about the general nature of conscious experience are set out in Chapter 9, and these are all amenable to scientific testing and debate.

11.9 Metaphysics

To me this account makes sense of what is happening, what we are experiencing as we go through life without requiring any mystical properties of the human mind. But if anything it increases my wonderment at the complexity of life and in particular what is achieved by the almost unbelievably complex "organic computer" the human brain.

There is a metaphysical question coming out of these propositions for which I have no answer. If the conscious experiences corresponding to all of sensory modalities are all identical to events occurring at different locations in the brain - if they are all identical to patterns of neural firing in the brain - why are they so qualitatively different?

Why is my visual experience with its colours and shapes and three-dimensionality so qualitatively different to my auditory experience with its variety of sounds? Why are my variety of taste sensations so different again? How can a burning pain be compared to the thrill of orgasm?

What I am saying is that we can lay down scientific knowledge about all of these conscious events. Science can establish how and when they occur, how they relate to external stimuli impinging on our senses where they are based in the brain. Science can establish fine gradations is quality of these experiences, and how we select these on an ongoing basis.

In this sense, the experiences are not private; science can provide us with valuable information to understand what is happening, with greater knowledge about conscious events.

But this does not answer the fundamental question – why are they so qualitatively different?

The answer that satisfies me is – <u>this is just the way it is</u>. The same question can be asked in different guise – Why is gold so different to silver? Why are the laws of physics the way they are – couldn't they have been different?

The task of science is to give greater understanding of the way things are; this goes part of the way to understanding "why", but will never fully answer the question of why it happens to be the way it is, and not some different way.

For me, this detracts nothing from the value of science. It does not suggest to me that I need a "creator", who decided it would be that way. Simply – that is just the way it is. I personally am quite content to live with this.

I have argued that our conscious events are <u>not private</u> in important ways. Because we offer identical descriptions of what happened in the blackened room when the banana flashed on the screen for one

second, I believe you had a visual experience identical to mine. This account proceeds from this basis to develop knowledge of ongoing visual experience.

But why is the yellow banana experience so different qualitatively to the barking dog, the police siren, if they are all patterns of neural firing in our brain?

My answer is – that is just the way it is – science has given me greater understanding of the events, but cannot suggest why they are so qualitatively different. But this "why so qualitatively different" does not detract from me knowing a lot about them.

I can accept that you may be unhappy with "that is just the way it is". So where do you go? Do you want a "creator" who decided it would be that way?

This doesn't click with me. None of the "creators" accepted by the world's prominent religions give any hint that they created the current universe with a big bang 18 billion years ago. None of them give any hint that they created life in very simple forms millions of years ago, to evolve into today's human beings. (In fact, the stories provided have no compatibility with either of these). Even the gurus not claiming to be creators (but to whom their disciples attribute incredible wisdom) have not offered insights into the nature of the universe comparable to what science has provided.

So are you saying – the currently-accepted creators were misinterpreted, or that their intermediaries at the time were just too ignorant to understand what they were being told? Or maybe these creators didn't really create, but there must be some new super-creator (not yet known about) who did the job?

Alternatively – if you are not happy with "that is just the way it is" or a super-creator – do you still want to say that the conscious experiences, because they are so qualitatively different, exist on a different "plane", on some "different level", to the physical world?

This would be a useful way to think if you want to believe that your conscious experiences have an existence independent of your brain or the physical world. This way they can go on existing after your physical death, perhaps to everlasting life, perhaps to eternal damnation. (But you still have lots of detail to fill out - were they shaped by your physical brain up until when you died, or when you had dementia – what is their ongoing guide without a physical body storing the memories, etc.).

To me – that is just the way it is. But science has given me greater understanding of how and what is.

I suspect that if you accept that "you" stop having conscious experiences when you die, and that your memory experiences die with you at that time, you will be more amenable to accepting – "that is just the way it is". On the other hand, if you are convinced that conscious experiences are going to keep happening after your physical death, you need to rely on their existence in a different non-physical universe, however hard this is to explain or conceptualize.