Experiments in space and time

Ross Day, Australian octogenarian perception expert, in conversation with Lance Workman

You have been working in psychology since the late 1940s. There weren't that many places where you could study psychology in those days – how did you get into it?

Back in the 1940s I started off at the University of Western Australia and I was going to do a medical course. In the first year I studied biological science, physics, chemistry, medicine and psychology – not because I wanted to be a psychologist, I just thought it was something different that would be interesting. It was – so much so that I ended up sticking with it and graduating in psychology in 1949. Following a brief period as a graduate assistant in psychology at the University of Western Australia I was offered the post of assistant lecturer at Bristol University, where I did my PhD in perceptual aspects of human skill. Following this I returned to Australia in 1955 to a lecturing post back in the sunshine at the University of Sydney. I haven't really stopped since then.

When you got back to Sydney, experimental psychology hadn't really taken off in Australia. Were you one of the founders?

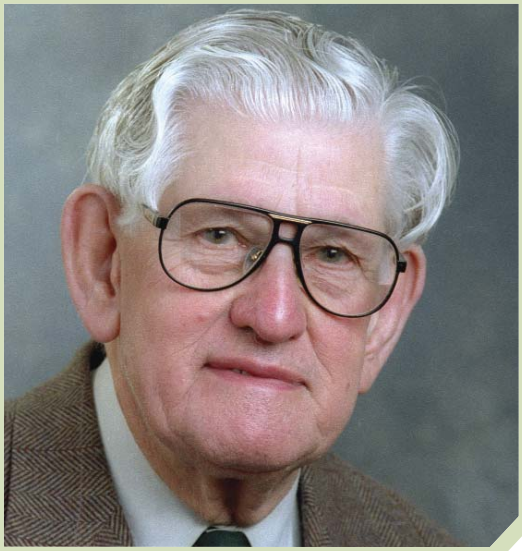
Yes I think so. People working within experimental psychology in Australia could be counted on the fingers of one hand – maybe two. There was very little going on in experimental psychology.

Your name is synonymous with visual perception and in particular perceptual illusions. Why do you find illusions so fascinating?

Because the way that illusions work offers us insight into how our perceptual systems work. Illusions are consistent across different observers, they don't disappear with repeated presentations and interestingly they also occur in sensory modalities other than vision, you can actually experience a Müller-Lyer in tactile mode. I think these facets of illusions tell us a lot about our normal processing abilities.

You've been involved in the psychology of perception since the late 1940s. How has it changed over that period?

It's changed in two ways really. First of all in the range of perceptual phenomena that have come under review. For example, James Gibson's work in particular led us into the external environment rather than looking at flashing lights or a vase in the lab continually. The second way is in the move towards studying the relationship between perception and attention. I think the work on the perception of change is particularly revealing. Like the study where the gorilla walks through the crowd.



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And nobody sees it?

That's right. We only perceive what we are attending to. A couple of years ago Max Coltheart showed that gorilla film to 300 fellows of the Australian Academy of Science. You know, the one where there are four people dressed in white and four people dressed in black, tossing a ball back and forth. During this a man dressed up as a gorilla walks through the scene. He said 'I want you to count the number of ball exchanges but only for the white group'. Afterwards he asked if anybody who had seen anything odd to put their hand up. Not one of the 300 distinguished experts put their hand up. He showed it again and asked them to look out for anything odd rather than counting the number of passes. All of them suddenly noticed this great shambling gorilla walking through! Lots of laughter this time round – but it illustrates just how much perception is now known to be a product of attention.

Coming on to specific visual illusions, you've published work on Müller-Lyer. Now, your explanation is quite different from Richard Gregory's. Can you take me through this?

It was generally thought that the illusion works because of 'misapplied' size constancy being triggered by the terminal angles. Hence Gregory has argued that you see the arrows as the corners of the outside of a building and the fins as the inside corners and this in turn leads you to a false sense of perspective – making the fins seem more distant and hence in reality longer. But there's a problem here as it still works if, instead of fins and arrows, you use squares or circles at the end of the lines. So it can't be about misapplied size constancy. This is also true of the Poggendorff illusion of misalignment – you know, the one where a pair of parallel lines that are intercepted by a pair of collinear oblique lines.

What people have tended to do is attempt separate explanations for each individual illusion. I think that they are really all based on two principles – whole-part determination and space–time reciprocity.

The whole-part determination means, as the name suggests, that the whole figure is the primary determinant of the illusion. Take the Müller-Lyer – the fact that it works for circles or squares suggests that it is whether or not terminal features are perceived as 'inboard' or 'outboard', to use a marine term, that gives rise to this illusion of unequal extents. The outboard elements appear as larger in area than the inboard ones. But for this to work you have to consider the

whole figure, not just the angles as the misapplied size constancy hypothesis would suggest.

With regard to the space–time reciprocity argument, this is related to the fact that the illusion also works over time as well as over space. You can demonstrate this by serially stimulating points on the skin. If the distance between pairs of stimulated points is different, then equal durations between stimulation will appear different. You find that as you increase the distance between the stimulated points then you also appear to increase the time between stimulations. In these kinds of settings, perceived time and perceived space are reciprocally related. This is further evidence that it can't be explained by misapplying size constants, as this would only work in a visual-spatial setting.

Moving on to culture and illusions, what about the notion that some of these visual illusions work better in our culture than others – does this stand up to scrutiny?

No, not really. Well, let's say I think the jury is still out on this. Deregowski, who was working at the University of Aberdeen, did get some slight cross-cultural differences when it comes to depth perception in pictures – but the similarities are much greater than the differences. There was quite a famous expedition to the Torres Straits around 1900 involving a number of eminent psychologists, including Myers. They figured that the aborigines living there would perceive things differently due to the fact that they weren't used to seeing things in straight lines and they don't have the conventional architecture that we are used to in the West. But they really didn't find their perception was very different. I don't think that the book is closed on this, but you don't change the perception of illusions very much with experience; it hardly changes them at all.

So most of the visual illusions appear to be based on innate universal principles. What about infants? You've done a lot of work on early infant perception. How has our view of this changed in the last half a century?

Ah, babies! It used to be thought that they really don't perceive very much. William James said in his *Principles of Psychology* that to the just-born infant the world is just 'a big booming, buzzing confusion'. It is not. They see far more, especially at the age of eight or nine weeks. It was Michael Wertheimer, of the University of Colorado, who was the son of gestalt psychologist Max Wertheimer, who really changed our view of this. In an age when fathers didn't do this sort of thing, he was present at the birth of his own child. Just after the birth he took the keys out of his pocket and jangled them at various locations in the room and saw that the newborn was able to turn his head in the right direction. This got him interested in just how much babies are able to perceive from an early age.

They are born with much more in the way of perceptual abilities than we used to think?

Yes, and this has changed a lot in recent years. If you look at the impressive research of Perrett at St Andrews on the perception of faces by, I think, cats, you will find that he showed convincingly that when the cat was presented with the picture of a face a particular part of the cortex responded vigorously. If the picture was then turned upside down the cortical response was greatly reduced. As I recall, many were reluctant to accept this outcome. However, since the development of MRI scans and other imaging techniques, it has become clear that there are parts of the brain which are specifically tuned to respond to specific stimuli. Perrett was a pioneer in this field. By linking perception to specific locations in the brain Perrett's work was seminal.

> "All of them suddenly noticed this great shambling gorilla!"

Now, to go back to your question, infants have a whole lot of perceptual capacities built in at birth. Wertheimer really started it, and I did a fair bit of work on size constancy with Beryl McKenzie over a period of years. In one of the experiments with young babies we were interested in establishing whether, when infants reach toward an aperture in a transparent screen to obtain an attractive object, their hand is appropriately 'postured' so that it can reach through the aperture. Thus the elongated aperture was either vertical or horizontal so that to reach and grasp the object the hand had to be appropriately posture in order to pass smoothly and unimpeded through the aperture. The point of the experiment was to establish whether young infants perceive and anticipate intervening apertures and prepare the hand postured appropriately. Astonishingly, at around six months of age they were able to do this.

So William James got a lot right, but that was not one of them.

That was not one of them. Of course, his ideas have been very influential. I remember when textbooks regularly used to demonstrate what babies saw when they looked at faces – which was always just a complete blur. In reality, of course, no one knew what babies saw, but they were very much seen as tabula rasa. What changed it all – and it was really an overnight experience – was the work of Eleanor Gibson and her student Richard Walk. They published the work on the visual cliff in 1960 showing that babies go to the shallow end but avoid the deep end – and that they have this ability to perceive depth from a very young age. That work really started to change the way we saw infant perception. This is true of animals in general: even dark-reared rats avoid the deep end.

It was later contended that when you place the same object at different distances away babies still see them as the same size. We have shown that this could not have been so because babies and infants don't look at stationary objects for any length of time when they are beyond certain distances. We looked at whether at around three months infants can discriminate visually between different patterns at different distances and when stationary and moving. This was a contentious issue at the time – in the early 1980s. Elfreide Ihsen and I used a strongly patterned cylinder that could be presented to the babies when it was either stationary or rotating at a viewing distance of either 1 or 10 metres. We used fixation time as our measure of attention under the four conditions. The results were marvellously clear-cut: three-month-old babies would look 'endlessly' when the cylinder was rotating at both distances, for relatively brief periods when it was near and stationary and virtually never when stationary and far away. In other words, babies love movement, which explains why my babies were quiet and attentive outside in a pram under a tree. We later found that Kurt Koffka had pretty much reached the same conclusions about infant perception of moving and stationary objects as we did, which he reported in his *Growth of the Mind* in 1925!

Where will your work go from here?

I have been working on perception and perceptual processes now for 60 years, so at 81 I am unlikely drastically to change my interests or the sort of problems I tackle. Illusions, especially the geometrical effects, have not yet been satisfactorily explained and still intrigue me. I think they will keep me busy.