The Allen L. Edwards Psychology Lecture Series

Sponsored by the University of Washington, Seattle, Washington

A review of a television lecture presented by Dr. Melvyn A. Goodale, research professor of Visual Neuroscience for the Department of Psychology at the University of Western Ontario in Canada

By James J. Asher, Ph.D.
Emeritus Professor of Psychology
San Jose State University
San Jose, California
July 2007

This lecture captured my attention because Dr. Goodale explored the latest research for visual perception and motor responses (grasping, picking up, placing, and touching). He compared our experience of identifying what is outside us with finding where things are located. Since motor behavior is central to my Total Physical Response (TPR), I wanted to know more about how it works.

Dr. Goodale mentioned that ten years ago little was known about cerebral visual pathways in the brain until neuro-imaging (known as brain scans) became available with MRI and SMRI. The data suggests that signals coming into the occipital cortex, where vision takes place at the back of the brain, divides into two pathways: a dorsal stream of activity that travels towards the top of the brain and a ventral stream of activity that travels downward. Either can operate independently, but they interact seamlessly in normal everyday events in ways that are still unknown.

The role of evolution in vision

Motor behavior in the dorsal stream may have appeared first in evolution because it directs the organism to food, for example, in grasping and picking up with one's hand or mouth. The motor system came first, followed perhaps thousands of years later with the development of visual perception necessary for communication, planning and other cognitive activities.

Evidence from brain damage:

The cases of Patient DF and Patient RV

Patient DF is a young woman who suffered visual agnosia following near asphyxiation by carbon monoxide. Visual agnosia is an inability to recognize faces of friends and relatives or the shape of common objects. DF is unable to tell the difference between simple geometric shapes such as a triangle or a circle; however, she has no trouble identifying objects if they are placed in her hand.

If you ask her to describe the width of a block with her index finger and thumb, she is inaccurate on every trial, but if you ask her to reach out and pick up a block, her index finger and thumb are exactly the right width that matches what we would expect from a normal subject.

Patient RV is a patient with optic ataxia, an inability to guide the hand toward an object using visual information. If you ask her to use her index finger and thumb to pick up a block, she is wildly inaccurate on every trial, but she has no difficulty verbally describing the orientation and width of each block.

Visual illusions:
You can fool the left brain but not the right brain

Visual illusions have fascinated us for more than a hundred years. For example, Figure 1 is the Müller-Lyer illusion. Both horizontal lines are identical in length, but the vertical line in red on the top appears to be shorter than the vertical line in red on the bottom.

Figure 1

My explanation

In my book, *Brainswitching: Learning on the right side of the brain*, I explain the visual illusions as a microsecond analysis with "instant logic" by the left brain like this:

In Figure 1, A is closer to me than B, therefore, if both horizontal lines are the same length, then the horizontal line in A should appear longer than the horizontal line in B. Since it does not, the line in B which is farther way is longer, and that is what we "see." That is the illusion. That is the false conclusion.

However, Maurizio Gentilucci and his colleagues (1996), Ian Whishaw with the Ponzo illusion, Richard Gregory (1997) with the Hollow Mask illusion (1998), and Melvyn Goodale (1998) with the Ebbinghaus Illusion demonstrated that when you ask subjects to grasp, touch, or pick up something in the display, the illusion disappears. Their body makes a correct decision even though visual perception gives them a false conclusion, which is the illusion. To me this dramatically illustrates a brainswitch from one hemisphere to the other.

The Ebbinghaus Illusion

Salvatore Aglioti and his colleagues (1995) set up an ingenious experiment with the Ebbinghaus Illusion in Figure 2. Subjects typically report that the small circle surrounded by the smaller circles appears larger than the small circle surrounded by the larger circles.

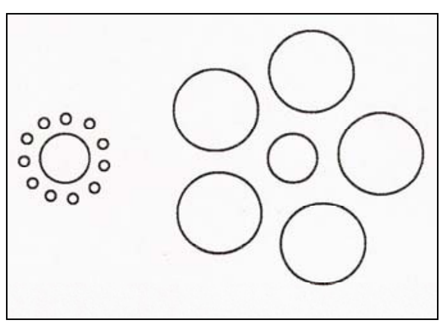

Figure 2

If we increase the size of the small circle surrounded by the larger circles, both of the small circles appear to be identical as shown in Figure 3.

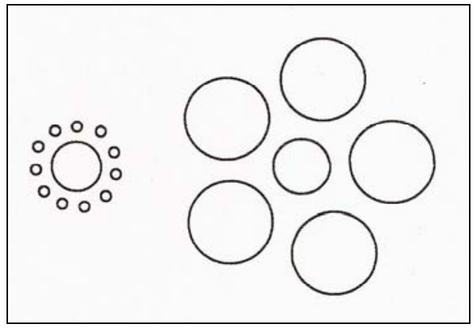

Figure 3

Now, Salvatore Aglioti built a three-dimensional version of the Ebbinghaus Illusion as displayed in Figure 4:

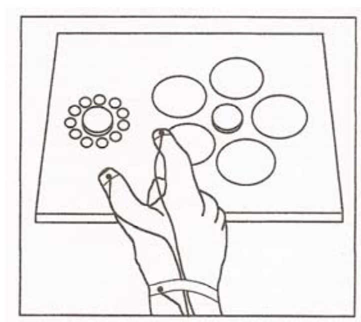

Figure 4

The hand you see is a subject with infrared emitting diodes attached to the finger, thumb and wrist. The instruction to the subjects was to reach out and pick up the small circle. When their fingers reached out, the width between the finger and thumb exactly matched the true size of the circle rather than the "illusion" size. Although subjects perceived the illusion, their body discerned the true size of the target object they were about the grasp. This study was replicated and confirmed by Haffenden and Goodale (1998).

Vishton and Cutting (1995) and Gentilucci et al., (1996) found the same result with the Müller-Lyer Illusion when subjects reached out to grasp the horizontal line, their finger and thumb exactly matched the true size rather than the "illusion" size. This exciting finding has also been demonstrated for the Ponzo Illusion (Ian Whishaw, personal communication) and the Hollow Mask Illusion (Gregory, 1963).

Implications

The left brain generates an illusion with "instant" logic, but the right brain operating without an evaluation of the display, discerns true relationships in the external world. The grasping, touching and picking up of objects is consistently accurate even though the subject is fully aware of the visual illusion. This makes sense since the motor system is more primitive in evolutionary development. It has to be accurate for early humans to survive in the search for food. Primeval humans did not need a complex visual perception of the world to achieve four basic goals: food, water, mating, and the avoidance of danger.

Why humans developed complex visual perception: How it relates to survival in a complex society

Primitive humans were, from an evolutionary point of view, "animals who could talk." Talking might have been at first rudimentary, but slowly became more complicated and sophisticated as communities slowly evolved into complex systems. Visual perception adapted much like the visual perception of early native people isolated in remote Alaskan villages. Their visual perception of snow has scores of subtle nuances with vocabulary to match. Understanding the intelligence of snow was crucial to their survival.

So, visual perception and the vocabulary to describe what we see may have developed together because these skills were, and still are, critical for anyone to survive in a community such as a city. For example, to get food, to get water, to mate, and avoid danger, one must acquire a bundle of skills and information to be an accepted member of society. One must be a "civilized person" for access to food, water, a mate, and safety from predators in another tribe (i.e., another nation).

Notice that almost none of those skills and information was necessary for the safety and comfort of primitive humans. The first "animals to stand up and talk" did not need reading, writing and mathematics. Nor did they need finance, parenting, insurance, checkbooks, or etiquette plus thousands of other pieces of information that requires one to spend years in a special place called, "school."

How the Total Physical Response (TPR) fits into the picture

When we direct another person's behavior with an utterance in a target language, which is the essence of TPR, we have activated a primitive sensory system that operated successfully perhaps thousands of years before the appearance of a sophisticated visual experience with concepts in a hierarchy of abstraction and analysis. In the beginning, no high level abstractions were necessary to "see" and perhaps "smell" a target, hunt it down, then move our hands to grasp and eat. If humans hunted in "packs," then some rudimentary utterances would be a valuable asset to coordinate the hunters. This may have been the beginning of language.

Evidence to support this hypothesis comes from anthropological studies of tribes isolated for centuries. Their vocabulary is often limited to basic items needed to hunt or fish or farm. Some have no vocabulary for “time” such as the present, past, and future.

The mystery of grammar

However, still an intriguing mystery is this: What is the survival value of grammar? Grammar is perhaps the most significant feature of language that differentiates us from apes. Play with these two strange facts: First, we share about 98 percent of our DNA with apes. Second, apes can learn individual vocabulary items (at a limited level of abstraction) using their hands to make signs or by pressing pictures on a computer screen, but grammar seems beyond their comprehension. Why?

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Dr. Melvyn A. Goodale can be contacted at the Department of Psychology,
University of Western Ontario, London, Ontario, Canada N6A 5C2

The writer welcomes your comments or questions,
His e-mail is: tprworld@aol.com