

SOME THOUGHTS ON THE RELATIONSHIP BETWEEN:

VISION PROPRIOCEPTION KINESTHETICS

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ABSTRACT

In addition to the geniculo-calcarine, there is a separate "second visual" pathway. This "second" pathway is sub-cortical, allows for the direct visual control of movement, and for the most part operates outside of conscious awareness. A practical technique derived from the Feldenkrais Method of psychophysical education is presented to enable the reader to experience an improvement in the workings of this pathway for himself or herself.

KEY WORDS

vision, movement, Feldenkrais Method, blindsight, instrumental vision, ambient vision, vision therapy

Studies of the visual system in humans and animals up to the early and middle part of this century concentrated on the eyes, the visual cortex, and the neural structures between them.^{1,2} It is this part of the visual system that allows the brain to receive photic information from the environment and to enable us to "see," in the usual sense.

More recent research has uncovered a second visual pathway that leads to a sub-cortical area of the brain.³

The visual cortex is primarily concerned with what might be called the cognitive aspects of vision. It is this part of the brain that allows us to name and talk about objects that we perceive visually. If enough of this area, or the nervous paths leading to it, is damaged, blindness results.

The sub-cortical visual area, on the other hand, appears to be concerned more with visual control of movement.

If we consider vision from an evolutionary standpoint, we can get some idea of the importance of vision in relationship to movement. For millions of years our animal and human ancestors depended on effective vision for survival. The fox chasing the rabbit, or the cheetah the gazelle, must be able to translate visual cues instantly into proper movement to obtain food. Conversely, the rabbit or gazelle needs to do the same to survive. Tree-dwelling primates must be able to judge the exact location and position of a branch to avoid falling during a jump.

How does the brain translate visual cues into movement? Experiments performed on those with damage to the visual

cortex suggest that there is a subsystem within the visual system that works to organize movement, and that it functions outside of our usual, conscious awareness.^{4,5}

Subjects with damage to the visual cortex were presented with a target outside of their functioning visual area. Unable to "see" the target, and thus to describe or name it, they were nevertheless able to point at it with considerable accuracy.⁶

This phenomenon was originally called "blindsight,"⁷ and the direct visual/motor link has been called "instrumental vision"⁶ or "ambient vision."⁸

The neural pathways that are thought to mediate this instrumental or ambient vision in man lead from the retina to the superior colliculus.⁹

A number of investigators have noted the connection between vision, movement and posture,^{10,11} and optometric contributions to this field have been described in such books as *Total Vision*¹² and *Eye Power*.¹³

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In the early 1980s I developed a series of techniques that are intended to improve the functioning of this second visual system. In initial experiments, first with myself and later with small groups of people, I found that the techniques could enhance the judgment of distance, posture, eye-body coordination, and the overall quality of vision. Also, excess muscular tension and pain associated with it, especially in the neck and shoulders, would often be reduced.

In constructing my techniques to improve visual functioning, I found four ideas useful as guiding principles.

The first principle is that there is an ongoing relationship between vision, kinesthesia and proprioception. To this end I continuously remind the trainee to attend to what he sees, and at the same time to attend to his body. Improvement is produced by simultaneously paying attention to what is felt and to what is seen. I usually ask the trainee to move his attention through his body, feeling, for example, how the pressure on the soles of his feet changes, what he can feel in his ankles, then knees, hips, shoulders, or neck. This heightened proprioceptive awareness improves both vision and movement.

The second principle is that as we see, we construct an internal visual/kinesthetic map of the environment and we then act on this map. Thus, while the trainee is performing a technique, I ask him to consciously pay attention to an external target, then to close his eyes and visualize the target's position, and then finally to open his eyes and compare the position of the imaginary target with the position of the real target. Learning, or improvement, occurs when the trainee discerns a discrepancy between the two.

The third principle is that vision is maximized when we are aware of the total visual field. To accomplish this, I ask the trainee to direct his eyes toward the target and also to pay attention to his peripheral vision while he is moving.

The fourth principle is that to enhance vision we should differentiate the movements of the eyes and the body. This differentiation, or the ability to move parts of the body independently of each other, is an application of a human developmental process.¹⁴

The first principle, the visual/kinesthetic connection, has been verified by experimenters. Human volunteers, wearing inverting prisms, manage to right their perceptual world fairly quickly if given the chance to actively move in and through the environment. Experiments with young animals have shown that functional blindness can result if they are deprived of the chance to manipulate or actively explore the environment.^{7,15, 16}

Moshe Feldenkrais, who originated the system of psychophysical education that bears his name, propounded the second principle, the importance of proper internal visual/kinesthetic maps for good action. In constructing his system of

psychophysical education, he stated that we direct ourselves to move in accordance with our physical self-image, which is a map of the physical body stored in the brain.¹⁴ This map is learned, as we grow from infant to adult, through exploring the environment and gaining greater experiential knowledge about our own bodies. Feldenkrais stated that this internal map frequently does not match reality, and that actions taken on the basis of it will often go awry, just as a person using an inaccurate road map may end up at some place other than his intended destination. I have extended this idea to include not only proprioception but exteroception.

Experimenters have also come to the conclusion that visual perception may consist, at least partly, of constructing an internal map of the environment.¹⁵

The third principle, that we should be aware of our whole visual field as we move, comes from the idea that peripheral vision, as opposed to central vision, is the seat of visual control of movement.⁷

The fourth principle, of differentiating the movement of the eyes from that of other parts of the body, is a general principle describing developmental learning. A newborn child has almost completely undifferentiated movements, being able to either contract all of his flexor muscles, and so roll up into a ball, or to contract his extensor muscles in the opposite movement. Learning to sit, crawl, roll over, walk and run, then, are accomplished by increasingly finer differentiations of the various muscles.

The technique that follows, taken from my workbook, *The Use of the Eyes in Movement*,¹⁷ is a practical demonstration of the application of these principles. It is one of 11 techniques in the book. To do the technique you will need an eye patch and a yardstick.

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For good action, the visual system must be able to locate an object in space in relation to the body. In order to do this the brain utilizes information not only from the eyes but also from the kinesthetic sense--that is, from the sensations of movement of the body. Thus, to a certain degree, we see with our whole body and not just with our eyes. In the following technique, we will explore and improve this function of the self.

Now, take your yardstick and prop it up so that it is vertical and the top of the

stick is just below eye level when you are standing. Arrange the stick and its props so that it is two or three feet in front of a blank wall. Cover your non-dominant eye with the eye patch and stand about five or six feet away from the stick in such a way that an imaginary line drawn from your eye through the stick to the wall meets the wall at a right angle. Put some object on the floor by one of your feet to mark your place so that you can do the whole technique without changing your position relative to the stick.

Take your place facing the stick and fixate your dominant eye on the top of the stick. While you fixate the stick, begin to shift your weight toward the side of the eye that is open and then come back to center. Continue to shift your weight to one side like this and attend to scanning your complete body.

Make sure that you continue to face straight toward the yardstick and just move your weight from one side to the other. Do not allow your body to turn to the side.

As you scan your body, notice how your weight shifts from the middle, over to one foot, and then back to the middle. Feel how the pressure shifts on the soles of your feet. Notice your knees. Do they bend at all as you shift your weight? How do your hips move? Your shoulders? Can you feel your eye moving? Does your breathing continue at a normal pace? As you move be aware of your peripheral vision. Notice what you can see all around the edges of your visual field as you move.

After you have done this for one to two minutes, continue to shift your weight as before, but close your eyes and look at the yardstick in your imagination. Shift your weight toward the side of the eye that is open and then back to center about five or six times, and then stop and open your eyes. Are you still looking at the yardstick? Repeat this sequence several times until the position of the imaginary stick coincides with the position of the real stick when you open your eyes.

Now begin to shift your weight to the other side, away from the side of the eye that is open. As before, notice how your body moves and how the pressure changes on the soles of your feet. Continue to move like this for one or two minutes, keeping your eye on the top corner of the yardstick.

Continue to shift your weight, but now close your eyes and look at the stick

in your imagination. As before, go back and forth several times with your eyes closed and then stop, open your eyes, and check to see if the position of the imaginary stick coincides with the position of the real stick. Repeat this several times.

Now combine the two previous movements and begin to shift your weight left and right, and keep your eye on the yardstick. Continue for one to two minutes and notice how your body moves and how your weight shifts from one foot to the other and back. Can you watch the stick and pay attention to the sensations of movement and weight shifting at the same time? Remember to pay attention to what you can see with your peripheral vision from time to time.

Now continue the previous movement, but close your eyes and track the yardstick in your imagination. As before, make five or six moves with your eyes closed and then stop moving, open your eyes, and notice if you are actually looking at the yardstick. Be sure to pay attention to the sensations of movement in your body as you track the imaginary stick. Repeat this sequence five or six times and then stop.

Take off your eye patch and look around. Look at objects up close and at a distance. Look with one eye open, then the other, then with both eyes open. How does the world look? Close your eyes and direct your attention to your eyes and face. Which eye feels bigger? Move your closed eyes a little bit from side to side. Does one eye feel as if it moves more easily?

By observing the mismatches and changes, you cement the learning that has occurred and begin to function at an enhanced level of visual/kinesthetic integration.

Patch your dominant eye. Return to the place that you marked on the floor and repeat the previous movements with the non-dominant eye open and watching the stick. Do you learn with the non-dominant eye as fast as with the dominant eye? After you have finished working with the non-dominant eye, take off the patch and view the world again.

Now return to your place on the floor several feet away from the yardstick. With both eyes, look at the top of the stick and begin to shift your weight left and right. Watch the stick and notice how your

weight shifts left and right on the soles of your feet and how your body moves. Continue to look at the stick and be aware of how far you can see to the left and right and up and down.

After two or three minutes, continue to move, but close your eyes and track the stick in your imagination. After shifting your weight several times with your eyes closed, stop, open your eyes, and note if you are really looking at the stick. Repeat this sequence several times until the position of the imaginary stick and the position of the real stick coincide.

Now, shift your weight from left to right a few times with your eyes closed while watching the imaginary stick, and then stop moving, with your weight in the middle. Keeping your eyes closed, step forward and grasp the yardstick.

Make a single grasp and stop, and then open your eyes. If you don't reach the stick on your first try, go back to your place on the floor, shift your weight left and right with your eyes open, and then closed, and then again attempt to grasp the stick. Be sure to start from the same place on the floor each time.

As you go for the yardstick, do not make any special effort to hit it. Have the attitude that you would have if your eyes were open. If you proceed in this way, you should find that it is easy to grasp the stick.

After you have grasped the yardstick several times, return to your place and shift your weight left and right a few times with your eyes open, and then closed. Is there any change in your internal representation of the stick--that is, is the imaginary stick that you see with your eyes closed different in any way?

Walk around and look at the world as you move. Has your perception of it changed?

If you try this technique again, stand a little further away from the yardstick and, at the end, try to grasp the stick from this increased distance. How far away can you start and still grasp the stick?

I have found that utilizing these techniques over a period of time often results in improved binocularity, eye/body coordination, appreciation of colors, and overall visual ability, as experienced by both myself and my clients. I believe that techniques of this sort can be a valuable addition to optometric vision therapy programs.

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REFERENCES

1. Glickstein M. The discovery of the visual cortex. *Sci Am*, Sept, 1988: 118.
2. Duke-Elder WS. *Textbook of ophthalmology*. Vol. 1. London: Henry Kimpton, 1949.
3. Wurtz RH et al. Brain mechanisms of visual attention. *Sci Am*, June, 1982: 126.
4. Anonymous. Lingering hues orient perception. *Science News*; Oct 1991: 268.
5. Wolfe JM. Hidden visual processes. *Sci Am*; Feb 1983: 94.
6. Pribram K. (Interview). *Omni*, Oct, 1982: 176.
7. Hechinger N. Seeing without eyes. *Science* 81: March 1981: 42.
8. Anonymous. More to vision than seeing. *Science News*, Dec 1977: 393.
9. Wurtz RH et al. Brain mechanisms of visual attention. *Sci Am*, June 1982: 126.
10. Schmidt RA. *Motor control and learning*, (1st Ed.) Champagne, Ill: Human Kinetics, 1982.
11. Harmon DB. *Notes on a dynamic theory of vision*, Vol. 1: movement, posture and vision, 3rd Rev. Austin, TX: Published by the author, 1958.
12. Kavner RX, Dusky L. *Total vision*. Millwood, NY: Kavner Books, 1978.
13. Hoopes A, Townsend. *Eye power*. New York: Knopf, 1979.
14. Feldenkrais M. *Awareness through movement*. New York: Harper and Row, 1972.
15. Pribram K. *Languages of the brain*. Monterey, Calif: Brooks/Cole, 1971: 91-92, 101-104.
16. Finke RA. *Mental imagery and the visual system*. *Sci Am*; Mar 1986: 92.
- *17. Heggie J. *The use of the eyes in movement*. Boulder, Co: Woodstone Books, 1985.

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