

Harmon Revisited

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I can remember sitting in a seminar struggling to absorb as much data as possible, when a procedure was mentioned that I had forgotten about. I then wondered what else I could have forgotten about, what else had "slipped through the cracks."

After reading the works of Darrell Boyd Harmon, I wonder if his work has "slipped through the cracks." When I first read a yellowed copy of the Co-ordinated Classroom, complete with old fashioned pictures of kids sitting at desks and a photo of a child with a vertical line drawn down the center of his body, I was enamored by its relevance for us today.

Harmon, who suffered a severe head and neck injury in a near fatal accident, endured a period of blindness. Eventually he recovered, leaving his head and trunk permanently out of alignment. He went on to spend his career making a study of the growth processes in children, especially as related to the visually-centered aspects of learning as affected by environment. For ten years he was Director, Division of School Services, Texas State Department of Health, following an extensive career in educational research and teacher education.

In 1938 Dr. Harmon, collaborating with fourteen state professional agencies, undertook what would be a nine year project including one hundred sixty thousand children. In *The Co-ordinated Classroom*¹ (available through OEP) Harmon argued that poor postural habits actually warped a child's growing body causing many of the visual problems that we, as the behavioral vision care team treat daily.

*During the first three years an inventory was made of the physical and psychological difficulties affecting Texas school children. Simultaneously, a check was made of classroom factors which might be related to those difficulties. The children were given thorough pediatric, dental and psychological examinations; anthropometric measurements were made as well as other tests that included visual, educational, medical and dietary. The results of the examinations and tests were as follows:*¹

53.3% of the children had visual difficulties
71.3% of the children had nutritional deficiencies
30.2% of the children had postural difficulties
92.0% of the children had dental difficulties
75.2% showed signs of chronic infection

20.9% showed signs of chronic fatigue.

After an in depth investigation of classrooms, Harmon described the conditions that were found.¹

All of the classrooms were lighted by windows on one side of the room only. . . Artificial lighting ranged from rooms with two ceiling mounted enclosing globes and each covering a 100 watt lamp, to rooms equipped with six 500 watt indirect incandescent luminaries. . . Individual, movable or fixed seats were provided for the children in intermediate grade rooms while most primary rooms were equipped with chairs and tables. . . in formal rows paralleling the window walls.

After the inventories of the children and the classrooms were compiled, research into the ideal conditions of classroom environment began. Harmon sighted a major factor that shaped the direction the program took in studying classroom planning. Although a vast amount of research existed on vision and light intensity of work surfaces, the initial data indicated that the difficulties the children were having were more related to how the body was affected by imbalances in light, not just the discomfort of the glare itself.

The foot-candle measurements of the children's work surfaces varied from 62 foot-candles to 12 foot-candles in the same classroom while horizontal light varied from 180 foot-candles to 9 foot-candles at any given time. This meant that the child had many times more light striking his eye at a 45 degree angle than he had on his work surface. This crude index of glare showed ratios existing between light striking a child's eye at this angle, with the light on his work running as high as 7.5 to 1. Figure 1 shows a child sitting in balanced posture at a desk of proper height with balanced, even lighting, while Figure 2 shows the same student at the same desk with light pouring in from his left and slightly toward him. Notice the twist in posture, leaving the two eyes out of balanced alignment on the material.

Harmon soon recognized that the body adapted to these light conditions. So posture, in close visually centered tasks, as affected by the total distribution of light, was a major focus of the study. Harmon writes:

Within certain limits, the human body is an organic mechanism fitted to survive by it's capacity to adjust itself or its relationships to the environment in which it finds itself - to go into action to



Figure 1. Child in balanced posture, free to perform close visually-centered tasks. Lighting and working surface have been adjusted to meet child's needs.

establish balances with the forces and restraints which surround it such as gravity, light, sound, temperature and the like... To survive and grow in such a surround, the organism then must and does make compromise adjustments ...compromises which can use energy excessively, warp structure, or delimit or deviate the purposefully directed performances of the growing child.

These "adjustments" include such body structures as the eyes, muscles, bones, body chemistry, neural pathways, etc. It was in this context that Harmon discussed what he termed "body mechanics." Body mechanics is more than just sitting symmetrically with the spine erect. Actual x-rays of children's torsos in various balanced and unbalanced postures, indicated significant differences in the torque, force and compression of intervertebral discs of the spine. When the work surface was raised to a 20% angle, bringing the plane of regard more parallel to the plane of the face, it significantly reduced the compression of the intervertebral discs in the spine. Combined with the maintenance of the proper distance between the plane of the face and the plane of regard: **Harmon distance.** (See Figure 3), a minimum expenditure of energy was needed for the muscles to support the weight of the head and trunk against the pull of gravity. Harmon wrote:

The horizontal working surface has produced similar bodily mal-alignments and excessive stresses to those set up by glare and poor light distribution.



Figure 2. Child in unbalanced posture, due to improper distribution of light. Notice tilt of head to protect eyes from high brightnesses out of working field.

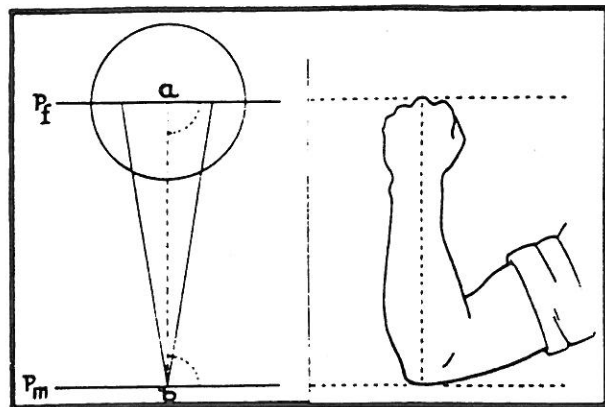


Figure 3. Method of determining working distance from intrapupillary point to point of fixation in close visually-centered activity.

On a horizontal surface, the child leans forward in an attempt to bring the plane of his face into parallel relationship with the plane of regard. Then, to support the added gravitational stresses on his back muscles, he begins to support his head with his elbow, thus creating an asymmetric posturing.

Another consideration is desk height. (To determine proper desk height, distance of the desk edge from the floor should be $\frac{3}{7}$ times height plus 1".) Or to put it simply, the desk height should be such that the child's feet can be flat on the floor and the eyes at the "Harmon distance" from the desk surface (see Figure 1). When the desk height was measured on 10,250 children, more than 87% of the children were in desks too high for them.

The closer the eyes are to the printed page, from poor posture and/or improper desk height, the greater the eyes must accommodate and converge. Reading tasks involve moving the eyes and refocusing them many thousands of times in a school day. When these muscles fatigue, we know that the ability to maintain a focused and fused image decreases accordingly. The question remains: how else is the child affected?

In reading, fatigue will precipitate losing one's place more often, omitting more words, misreading words one knows, and generally wanting to avoid near point tasks. But what about the long run? Is this situation moving some students toward myopia? Does this predispose some to AD(H)D, attention deficit (hyperactive) disorder?

When the student sits for hours asymmetrically, converging and accommodating unequally, viewing printed materials that are placed off center and/or in a slanted position, what does this do to his vision, his behavior? Are the neural pathways affected? These are some of the questions for which Dr. Harmon was seeking answers.

After analyzing a combination of data from many fields, plans for a co-ordinated classroom (thus Harmon's book's name) began. By August of 1947, "an advanced experimental center" was completed in the Rosedale School at Austin, Texas. "In the Rosedale school, an attempt was made to co-ordinate the findings in daylight control, artificial lighting, seating and seating arrangement, and room decoration to produce a unified working environment for the children that would permit maximum freedom of performance of their school tasks at a minimum physiologic expense."

Furniture was designed and constructed. The children at the Rosedale School sat in individual desks with a 20 degree writing surface. Special paints were mixed and applied to the walls (the color green relaxes the eyes), the lighting was measured and controlled, the blackboards turned green.

In the fall of 1942, after six months in the remodeled classrooms, 396 children enrolled in these classrooms were given the same visual, psychological, achievement and other tests that were given to them prior to making any classroom changes. Among the changes that were measured only 18.6% of those examined in November showed visual difficulties, as compared with 53.3% tested six months previously. The team of professionals also found a significant reduction of posture problems (reduced by 25%), a reduction of 55% for chronic fatigue, and a general achievement level increase of over 3 months was documented.

Over twenty years ago, Dr. Harmon decorated Dr. Robert Kraskin's office. Harmon gray remains to this

day. It must have been during that time that Dr. Harmon made a postural analysis of Dr. Kraskin's vision therapy patients. Harmon spoke of it during a speech he made to the Southwestern Congress of Optometry in 1965.

One of the steps of this study was to make a thorough statistical analysis of information obtained from one hundred randomly selected cases in the records of Dr. Kraskin. This analysis showed that there was a head posture component in the etiology of the problems of at least 71.5% of the cases.

Harmon believed that a flat working surface forces a child well outside his various tolerances.

Throughout Dr. Harmon's work, he references the spine as a gravitational point. In "Body Mechanics" (see Figure 4), the spine is not erect. While sitting up straight coincides with the gravitational axis, electromyographic studies show that "too rigidly erect" is not good for the child either (see Figure 5). In the erect position (Figure 5), especially if the child is working on a flat surface, the muscles of the neck are approaching maximum action in supporting the head "leaving little if any latitude for controlling body balance as the eyes move. Because of this position lateral excursions of the eyes in the lower portion of the working field require action of other extraocular muscles in addition to the laterals, thereby falsifying perception of spatial rela-



Figure 4. X-ray of spine of child in balanced posture. Note even distribution of pressure and forces at the intervertebral discs.



Figure 5. X-ray of spine of child in traditionally "erect" posture. Note uneven distribution of pressure and forces at intervertebral discs.

tionships, increasing postural stresses, and, referring incorrect angular stresses to the body frame of reference with a resulting distortion of direction and movement.

After measuring x-rays of spines sitting in an erect position, Harmon writes of the erect spine, "The intervertebral spaces... do not intersect the plane of the task, indicating possible stresses imposed on the statokinetic reflexes (body balancing and spatial orientation reflexes called into play by changes in body movement) ...thereby interfering with or falsifying the kinesthetic component of the visual performance of visual perception."³

Hanna Harmon who, as of this writing, (1990) lives in Austin, Texas, recalls a time when her husband was speaking to graduate students at Yale University. A student who was listening to Dr. Harmon, challenged him. Dr. Harmon responded to the student by saying,

From the place I stand, I can tell which is your leading eye. I can tell which is your chewing side and I can tell by the position of your neck that you have trouble hearing out of your right ear.

Mrs. Harmon also remembers another time when a representative of AT & T (a phone company in Dallas, Texas), heard Dr. Harmon speak. Afterwards, the phone representative told Harmon that there was a problem of fast turn-over and excessive sick leave among his telephone operators and he wanted Harmon to see if he could find out why. After observing, Harmon picked out three operators who he thought "were in trouble."

The manager was called in. Of the first operator the manager said that she was missing more days than she was there. Of the second, he said that she complained of headaches constantly, and the third one had just given notice because she "just couldn't take it any longer." Dr. Harmon suggested that the phone company change the filter (illumination) on the viewing screen.

Self Evaluation

Now become aware of your own reading posture. Where is your light source? Does your head create a shadow on the page? Are you holding these papers in a plane parallel to your face, or are you reading on a flat surface? Is the placement of this paper centered or is it off center from the plane of regard? What is your body doing? Ask these questions again while you observe vision therapy patients in the training room or children in a classroom.

In his book, *Notes on a Dynamic Theory of Vision*,³ published in 1958, Harmon brought attention to an outmoded concept that learning was passive absorption. It would be in this context that the "eye is like a camera" would fit right in.

Education has long demonstrated that a child grows, develops, and learns through action, both implicit and overt... by means of concrete actions and experiences before symbolization: actions toward the forms of symbols themselves: and actions after meaningful experience."

The second outmoded concept that Harmon discussed was that vision has nothing to do with learned reactions and the learning of motor skills. "...a motor skill is actually... spatial direction of movement in relation to a frame or frames of reference."³ Harmon believed that from the interaction of the mechanisms for moving the eyes and a gravitational reference point, we construct for ourselves a frame of reference of visual space. Vision, he said, could not be considered separately from the part it plays in the support and movement of the organism. And if "...learning and purposeful action is direction of movement in visually centered tasks"³ (80% of the school day), then we should be paying close attention to both the comfort, lighting, and posture in all visually-centered tasks.

'Heredity supplies the materials out of which environment makes the man.'

When Harmon spoke to the Southwestern Congress of Optometry February 14, 1965, he said, "We all have favorite statements that we repeat. One of mine is that 'Heredity supplies the materials out of which environment makes the man'." Dr. Harmon went on to say that we are what we have seen and felt and done. Noting that

these are not separate functions, but only different aspects of one and the same process, vision.³

All of us are well aware that, no matter how accurate their optical function must be, eyes are not cameras... Meaningful vision is learned—learned like every other learning—by doing, by the constructive use of bodily stress ... This integrating, checking, comparing, redirecting, and abstracting, taken together, make for the structuring of meaningful vision.

As an optometric vision therapist, I often go into the schools to talk with our patients' teachers. Usually a room has been assigned to us in the office. There is a sign that reads, "Check into the office" on the outside of the school door. I usually follow the rules.

About a month ago, after I began research for this paper, I arrived at the school a half hour early and ignored the warning on the door. I entered a second-grade classroom of a 20-year teaching veteran who was training a student teacher. As in Harmon's day, windows covered the top half of one wall. There were no shades on the windows as they were tinted. The children sat in two-person desks arranged in a horseshoe fashion with some children facing the windows (light) and others with their backs toward them.

The windows were on the west side and it was a cloudy day. I sat in the back of the room observing the children's postures. Many of the children were sitting on books. Over half of the tables were paired with tiny chairs. When I spotted our therapy patient, her desk was so high that even with erect posture her eyes would be less than 6 inches away from the table. Later her teacher complained that the little girl was having difficulty attending at the nearpoint.) About half of the children were resting on one arm, some with their heads practically on their desks, while they were doing their math problems. I tried to observe all the things Harmon talked about, including placement of the materials on the desk. The desks tops, incidentally, were flat.

After the children went out to recess, I talked with the teacher about Harmon's findings. She mused, remembered going to Catholic school where the nuns would make the children sit up straight. She admitted that she didn't know the reason for it until now.

We can help teachers help kids by volunteering to evaluate proper desk and chair heights for their students.

Experience Determines Development

In "Lighting and Child Development," Harmon wrote:

Within the limits set by heredity and intra-uterine development, the extent and manner of a child's growth and the direction of his development and

his later health are determined by his day to day experiences. If they are warped, he becomes warped. If they are beyond his maturity or capacities, or if they produce continued bodily stress, his growth and development are deviated in the direction of inefficiency, breakdown or lesion.

Harmon used the analogy of a bad telephone circuit. If there is "noise" on our neural pathways we cannot see with full meaning. Eventually, a visual maladaptation results. Medial tilts of the head both forward and backward, accompanied by a superior or inferior convergence results in intorsions (twisting inward) or extorsions (twisting outward). These cyclic actions, when a head tilt is maintained, results in astigmatisms induced by the cyclophoric function. In his book, *Notes on the Dynamic Theory of Vision*, Harmon sighted a study by Finnegan and others that there is a correlation in the following relationships:³

Subjects with astigmatism characteristically tilt their heads laterally (sometimes accompanied by a rotation of the head)...the degree of tilt also tends to show a functional relationship with the axis of astigmatism.

Harmon wrote:³

An established ophthalmological principle states that differences of intensity of illumination between the two eyes amounting to over 12% leads to the suspension of vision in one eye....The suspension of vision in one eye is due to this angular reduction of illumination.

(Angular changes greater than 20 degrees).

This conditioned combination of eye movements necessary to follow lateral alignment, shifts his body adversely, and becomes a handicap to him in performing visually centered tasks...

Harmon not only cited astigmatism and suppression for being caused by or aggravated by adaptations to bodily stress, but he also included myopia, anisometropia, and high phorias. (Although I have not found any mention of strabismus in his writings, I wonder what he would have said about it.)

Myopia, Harmon said, was caused and/or aggravated by the tendency to incline the head backward and lead with the chin. Hyperopes are the other way around, inclining their heads forward and leading with the forehead. Both groups show distinctive handwriting differences.

About foveas, Harmon sighted Grossefeld⁴ in saying that the object of the fovea was not just acuity, but to give us a field or a space center, a reference point.

To disturb the mechanics of being aligned (foveal projections) ... and you disturb the mechanisms of bi-lateral foveal alignment within the needed

oscillatory movements for scanning. As a result, visual space is disturbed and recognition is distorted.

Harmon argued that "Anisometropes (a difference in the refraction between the two eyes) tend to rotate their heads so the x-axis of their head is out of parallel with the x-axis or their upper trunks.

He cited a Lowman and Mills study⁵ of 1915 in which they showed that "skeletal alignment effected convergence function, in what was then known as phorias." This included hyperphorias.

If the child is fixating on an object at 20 feet or more, he is receiving (essentially) parallel rays of light on the two retinas. Conversely, any object within 20 feet requires the eyes to converge, which requires the coordination of the six pairs of extraocular muscles as well as the muscles controlling accommodation.

In *A Dynamic Theory of Vision*, skeletal adaptations to esophoria and exophoria are described.³

Even some abnormal positions of the scapulae are associated with visual problems. Exsophores tend to elevate and rotate their scapulae obliquely and upward, as if they were thrusting their arms vigorously out into space. This is apparent when they are standing in a relaxed balanced position. Esophores, on the other hand, tend to depress their scapulae and rotate them obliquely and inward, as if they were pulling their arms and shoulders backward and away from visual space.

It is known that a person can often be made to stop suppressing his eye while pressure on the opposite shoulder is applied. As optometric vision therapists, we know that rocking the body, shifting body weight from one foot to the other, helps control suppression. Fusion has been initiated by pulling and pushing on the legs of a patient while lying on the floor. So the body is involved in the entire process of vision. The message is clear. Knowing that an individual's visual condition is continually aggravated by poor lighting and or postural habits at school and at home, we need to address ourselves strongly to that. We need to teach and monitor postural habits. We need to educate parents and teachers.

So the body is involved in the entire process of vision.

In a speech Harmon gave, which the COVD later reprinted in a pamphlet entitled "Restrained Performance As A Contributing Cause if Visual Problems," he said:²

Analysis of the current data also shows that poorly functioning body mechanics enter into the problems of at least 65% of the hyperopes, 78% of the anisometropes, and approximately three-quarters of the astigmatism. Analysis is

not yet complete of the possible postural components in causing problems of the myopes, but present indications point to the possibility that percentages are as high ...

The schools, especially the primary grades, could improve the quality of education simply by changing the furniture and monitoring light and posture. A return to the individual slanted desks, fitted to the size of the student, arranged in long rows facing the chalkboard, would contribute to greater performance. This, coupled with short motor breaks in the classroom (catching a ball in a can, chalkboard circles, jumping jacks, etc.), and an emphasis on ball activities at recess would greatly reduce the number of children with visually-related learning problems and the many who remain undiagnosed.

Last week, when I returned from my visit to the second-grade classroom, I happened to speak with my optometrist's wife, about Harmon and the conditions of our schools. She told me that her son had been complaining when his first grade teacher gave her a call. The teacher thought her son might have ADD (attention deficit disorder) because he often stood at his desk instead of sitting like the other children. When the mother asked her son why he behaved like that, the boy replied, "The desk is so high I have a hard time seeing my work." (Incidentally, the boy did not have a refractive error.)

In summing it up, Harmon wrote, "If, in meeting a new or only partially assimilated experience, a child reproduces what he senses, and learns what he reproduces, as the laws of learning through activity seem to imply, it does not take much ... to begin to wonder what is happening to the visually-related learning of many school children."¹

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