ject sounds, because they are meaningless; his responses at best will be very "in and out," so average test results will be useless. This "in and outness" usually reflects itself in family contention, as to whether the child can hear or whether he is a behavior problem.

Where history and simple office tests cause suspicion of hearing impairment, a definitive examination should always be sought. Delay may mean losing an opportunity to start the rehabilitation early, at the time when the best results can be obtained.

OFFICE EVALUATION OF VISION IN CHILDREN

By Frank Duncan Costenbader, M.D.

I AM PLEASED to be included on a panel discussing the special senses in conjunction with intelligence and certain skills. It would seem that in so grouping these subjects, the eyes, the ears and the other senses have no longer been considered isolated phenomena but as parts of an integrated whole.

It seems important at this early point in the discussion to emphasize the fact that the term "vision" is frequently misused, usually only connoting visual acuity. It should be emphasized that vision in its broadest sense includes visual acuity, the extent of the fields of vision, the normality or abnormality of binocular vision, and the adequacy of the visual associations such as recognition, identification and memory. It seems superfluous to point out that excellent visual acuity, if seen through a gun barrel, is by no means satisfying. Also, that a full, wide field of vision, when the object of interest is blurred, is most unsatisfactory. Having two eyes, each of which is a perfect unit, but not seeing together well and comfortably, is most annoying and handicapping. Finally, referring back to the brain a perfect visual image, which cannot be properly recognized and identified and then correlated with similar images previously received, is a totally frustrating experience.

Thus, for a child "to see well" he must see clearly the thing he looks straight at, he must see widely the things about him, as well as the object of interest, he must have his two eyes properly co-ordinated, and he must be able to recognize, identify and associate this image with related images and activities of the past.

TELL PARENTS ABOUT EYES

In the practice of pediatric ophthalmology, it has long been apparent that even though an adequate examination is carried out and proper treatment prescribed, the end result is not attained unless the parents understand something of the nature of a child's eyes and their child's specific difficulty. In order to properly clarify such an explanation, I frequently liken the eye to a camera. The aperture of the camera corresponds to the pupil of the eye, regulating the amount of light admitted. The lens of the camera is like the lens of the eye with the exception that the lens of the eye may change in shape, thus changing the focus of the eye, while the lens of the camera cannot. On the other hand, the length of the chamber, which in a camera *is* adjustable to help focus, is of fixed amount in the eye at any one time, and thus is not adjustable. The film or photographic plate of the camera corresponds to the retina and "records" the picture.

Here, however, the analogy breaks down. The camera film is equally sensitive both

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in its periphery and centrally, while the eye has acute, detailed vision only centrally, and less acute vision peripherally. The camera works as a single unit, while the eyes must work as a team and integrate their two pictures. The stereo cameras approach this, however. While the film of the camera receives the final optical impression, the retina is but a way-station through which the visual impression is passed through the optic nerve and the optic radiations to the occipital cortex. The camera has nothing comparable to the visual association areas which have to do with recognition, identification and visual memory. The pediatrician may find these likenesses and differences helpful in discussing "eye problems" with parents.

AGE AND THE CHILD'S VISION

It seems pertinent to outline the visual qualities of a child and to qualify these in terms of age and significance.

Visual acuity is not an absolute finding. It results from both physical and mental maturation. The baby at birth has questionably central fixation, fair central fixation at 3 months, a visual acuity of approximately 20/70 at 2 years, 20/30 at 5 years, and 20/20 at 7 years. The determination of this visual acuity in the pediatrician's or the ophthalmologist's office does not suggest that the eyes are perfect, but only that the eyes are capable of obtaining normal vision, by whatever means and at whatever price.

Sometimes normal vision has been obtained only when excessive accommodative effort is put out to overcome existing *refractive errors*. These refractive errors, due to irregularities in the size and shape of the eyeball, may either cause poor vision, if they cannot be properly accommodated for, or discomfort when they can be accommodated for and the child insists on seeing well in spite of the excessive accommodative effort involved. The terms "asthenopia" or "eyestrain" indicate the discomfort due to excessive accommodation.

Refractive errors often are poorly understood by others than ophthalmologists. Hyperopia (farsightedness) is customarily present in the infant and continues to be present until the early school years. At about the time the child is beginning to grow taller and thinner, usually the early school years, the eyeballs also begin to grow longer in their anterior-posterior diameter, and in so doing, hyperopia lessens, at times disappears, and myopia may occur. Myopia would seem to be present in about 1 out of every 10 teen-aged persons, though this varies greatly among the races. When a person has become myopic, there is no known way of favorably influencing the myopia (e.g., by such attempts as exercises, vitamins, diet, glasses, etc.), and usually the myopia will continue to progress until the upper teens or the lower twenties, and then remain stationary for a number of years thereafter. It is most reassuring to parents to be told that the onset and increase of myopia does not mean that vision has been lost, but simply that vision cannot be focussed adequately, and that glasses focus the good vision which is already present. The continued wearing of glasses neither makes the eyes better nor worse.

Since refractive errors may cause defective visual acuity, discomfort, or poor performance *only when not properly compensated for,* it seems important to emphasize that glasses need not be given unless unfavorable symptoms exist and then only for that period of time when the symptoms create a problem. Thus, the myopic child need only wear his glasses to see the blackboard, movies or television, unless he is happier wearing them all the time. The hyperopic child gets his most evident help in wearing glasses for prolonged near activity. The astigmatic child may get evident help from glasses for both distance and near gaze, but usually only when visual detail is at stake.

The recognition and testing of the *fields of vision* in a child are of much less importance than in an adult. Below the age of 8

or 10 years, the child's ability to co-operate and maintain visual attention are usually not sufficiently good to help in obtaining an accurate visual field. Further, the occasion for doing visual field testing in children is much less frequent than in adults. Constricted visual fields may be suspected when the child seems to see well the things he looks at, but bumps into things frequently or seems unaware of things to the side. Night blindness is a strong indication of grossly restricted visual fields.

Of especial interest is the female teenager who occasionally comes to the ophthalmologist's office complaining of not seeing adequately in school. On testing, a "gun-barrel" or "spiral" visual field is obtained. It is interesting that usually, while this girl denies being able to see a small test object further than 10 arc degrees away from the fixation point, she still has no nightblindness, no difficulty playing basketball or tennis, and does not run into objects to the side. This phenomenon is probably associated with emotional or glandular changes and would seem to right itself after a period of weeks or months.

In our testing and recognition of *anomalies of binocular vision,* we most frequently think only of frank strabismus, failing to recall that many individuals have a latent tendency to converge or to diverge, but the eyes are held in alignment by a strong fusion sense. When a latent tendency to deviate is present but is held under control by fusion, the eyes are grossly straight until alternately covered for a period of time, and then a manifest shift in gaze may be noted. Instead of having an obvious strabismus, this child has headaches, tired eyes, irritated lids and, at times, dizziness, as a result of insisting on holding straight eyes which have a tendency to deviate. The effort of maintaining binocular vision causes the discomfort.

On the other hand, *manifest deviations of the ocular alignment may occur at any time from birth to the school age, though rarely thereafter, except as a result of neurologic disease or injury.* When a manifest deviation occurs, several unfortunate things result. First, the vision in the eye not being used may suffer severely. Second, the pattern of binocular vision (fusion) suffers and thus the desire to become straight and stay straight is lost. Third, certain abnormal patterns of "seeing together" supervene, making the eventual cure of the strabismus more difficult. The earlier in life strabismus is present, and the longer it exists without adequate treatment, the more severe will be these difficulties, and the harder they will be to overcome. The early recognition and treatment of strabismus are most important. Strabismus is rarely an indication of neurologic disease, in the otherwise well child. Therefore, the history of pre-existing strabismus should be carefully noted in a suspected neurologic case when ocular deviation is observed. Such history would discount the strabismus as evidence of present neurologic disease.

Already mentioned but not sufficiently emphasized, is the fact that the eyes are but the windows of the mind (and the soul) and that faults of visual acuity, visual fields, refractive errors, and such-like by no means exhaust the broad consideration of vision. In cortical areas closely associated with and within the occipital cortex, there are ill-defined *visual-association* areas and other association areas. These areas having to do with interpretation and recognition are probably of utmost importance in the learning processes. Thus, in theory at least, and probably in actual practice, either the failure of maturation of, or subclinical damage to, these areas may well be a source of some of our more serious learning problems. In certain manifest trauma to the brain, various forms of agnosia, aphasia and alexia have been demonstrated. These findings are similar to those encountered in cases of severe learning difficulty. This statement in no way minimizes the importance of good educational methods, a proper emotional climate at school and at home, and good physical well-being, both

of the body as a whole and of the special senses. While this subject is being covered much more carefully by a following speaker, I believe that reading difficulties are seldom caused by defective vision, refractive errors, strabismus or other manifest ocular findings. Such findings may, however, aggravate and exaggerate the reading difficulty.

THE PEDIATRICIAN AND VISION

Having made some effort to place emphasis and give significance to ocular findings, it would seem helpful to comment on the pediatrician's role in the recognition and management of these findings. At *birth*, gross anomalies of the lids and globes may be readily recognized by external examination, while gross anomalies of the interior of the eye (cataracts, retinal disease, etc.) may be readily recognized with the ophthalmoscope. There would seem to be no danger in placing one drop of 2% homatropine hydrobromide in the conjunctival sac of the newborn baby, wait 20 minutes for the pupils to dilate, and then view the fundus with ease; 10% neosynephrine or ½% Cyclogyl® may also be used.

From the age of *6 months to 3 years,* the visual acuity of a child may be estimated by noting how securely and how centrally he fixates a light with each eye when the opposite eye is covered. The degree of visual interest in nearby toys, and animals and other moving objects at a distance, will give further information about the visual acuity. Checking the ocular alignment to determine the presence or absence of strabismus is most important in a small child. This may be done by shining a flashlight on the child's eyes and noting whether the corneal reflex is about in the center of each pupil. A more critical test for this, however, is to have the child interested in a small toy or a flashlight, and then alternately cover first one eye and then the other, noting whether there is a shift in gaze. If there is a significant shift in gaze, the eyes are not properly aligned. It must be recalled, however, that a small child's attention span may be short and that his visual attention may quickly lag, thus giving the impression of a shift or of poor fixation when only the attention is at fault. Repeating the test with a new object of interest, or a cookie or candy may be additionally helpful.

From the age of *3½ years to 6½ years,* visual acuity had best be tested by using the illiterate "E" chart, which is now standard for all kindergartens. Picture charts are not particularly helpful, since too much depends on the child's previous experience with the objects being pictured. One helpful thought in determining visual acuity at this age is that it is not important that the child shall recognize every symbol on every line down to the line of normal visual acuity. It is better to have the child recognize one symbol on each line until he "begins to stumble," and at that level, have him define each symbol of the line. Many children have lost interest in the "E" game, if too long a time is taken before the desired line is reached. It is important, also, at this age to check binocular alignment with a careful cover test. This, of course, is much more easily done now than earlier, and *any* evidence of shifting gaze when the eyes are alternately covered is significant. At this age, again, the fundi can easily be examined if there is any reason to suspect pathology.

From the age of 7 *years*, the visual acuity can easily be tested with the Snellen alphabet chart, and the child with normal eyes should be expected to read every letter in the 20/20 line with each eye separately. At this age, testing binocular alignment is less important, since strabismus infrequently appears after the age of 7 years. It is especially important at this age and later, to note symptoms of possible ocular discomfort. It should be recalled that many individuals have significant refractive errors, which, by accommodating excessively, they can overcome and thus attain normal visual acuity. However, in the process of so doing, the child may have recurring headaches, recurring nausea and dizziness, tired eyes, irritated lids, and a

failure to progress in school, which cannot otherwise be accounted for.

IN CONCLUSION

I would emphasize that:

1) Vision is a complex process involving two eyes and the mind.

2) Visual acuity improves with maturity and may be normal in spite of a significant refractive error.

3) Recurring and continuing discomfort may suggest a significant refractive error or a latent strabismus.

4) Learning difficulties rarely have the eyes as a primary cause, though at times they may be a contributory factor.

OFFICE EVALUATION OF INTELLIGENCE OF CHILDREN

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An estimation of intelligence in office practice is possible within the broad classification of average, defective and superior. I will first discuss the diagnosis of mental retardation in the young child.

DIAGNOSIS OF MENTAL RETARDATION IN INFANCY

When the infant, less than 2 years of age, comes for intelligence testing, mental retardation has usually been suspected. It is very difficult, at so early an age, to differentiate simple feeblemindedness from organic retardation. What the parent wishes to know is, is the child mentally defective and if so what can be done about it?

Severe Mental Retardation

The diagnosis of severe retardation offers little difficulty. The behavior of the infant in the office and the developmental history will establish the diagnosis. The imbecile and idiot (I.Q. below 50) are unable to do what the average child half their age can do. It takes them 2, 3, 4, or more years to learn what the normal infant learns in 1 year. Motor development is retarded and efforts at speech (babbling) are few and feeble. Inability to support the head, to sit up, to stand, to smile, to hold and handle objects at the proper time are valuable indices of mental defect.

It is rarely necessary to give an intelligence test to these severely defective children, as the level of retardation makes little difference in management and the prognosis for their mental development is already known to be poor.

The most severe cases of mental deficiency are easily recognized clinically. Usually the child is apathetic, lying quietly in the mother's arms but never looking at her or showing any awareness when she speaks. When picked up the child does not adjust to change in position, as does the normal infant, but remains quite still and relaxed.

Less often the child is extremely irritable, moving the jaws, rolling the eyes and crying constantly.

Severely defective children often show associated anomalies which can be recognized during the examination. Mongolism and cretinism need no discussion. Microcephaly and hydrocephaly are readily recognized, but one must be cautious in children with hydrocephalus as they are not always mentally retarded. Even moderate degrees are compatible with normal or superior mental functioning. Some deviations such as gargoylism, ocular hypertelorism,

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