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THE ASSESSMENT OF VISUAL ACUITY BY THE FORCED PREFERENTIAL LOOKING METHOD

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Abstract

Forced choice preferential looking (FPL) is a behavioural method for the assessment of visual acuity in preverbal infants. Using apparatus, designed and built locally, we tested 63 babies whose ages ranged from 6 weeks to 11 months on photographically generated grating targets. We could measure binocular acuity in 51 (81%). Our results show a progressive improvement in visual acuity until approximately 6 months of age. Our results in a small number of babies older than 6 months indicate the standard FPL technique is unreliable in older babies due to inattention.

Key words: *forced choice preferential looking, visual acuity, infant.*

Forced choice preferential looking (FPL) is a non-invasive behavioural method for the assessment of vision in babies and infants. It was mainly developed by psychologists for studies into the development of vision in normal children.[1,2] Its potential use as a clinical tool is only beginning to be realised.[3-6] The method derives its name from the visual behaviour observed when a baby is presented with two objects: one patterned, the other of equal luminance but with a visually homogeneous surface. Provided that the baby can resolve the detail on the patterned object it will fixate this object in preference to the homogeneous object. This behaviour is what is observed when a child fixates its mother's face. In its simplest form a device to observe this phenomenon is seen in Figure 1.

By displaying the patterned object as a series of alternating black and white stripes (i.e. a visual grating) the child's acuity can be estimated by varying the spatial frequency of the grating until the child no longer displays a fixation preference. The last grating on which a significant fixation preference is displayed is considered to estimate the child's acuity. High contrast visual gratings can be correlated with Snellen acuities giving the clinician a more familiar measure of the child's visual performance.[1] Unfortunately, if the side on which the test grating is displayed is known to the observer, bias on the part of the observer is introduced. To get around this problem the side on which the test grating is displayed can be masked from the observer (usually by having the gratings displayed by a second person) so that

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Figure 1: The child seated in the mother's lap is fixating the grating in the observer's left hand.

the observer's judgement of whether the child is preferentially fixating a particular grating must be made solely by the child's response. The observer's choice of the child's fixation preference is then decided only by the child's response hence the name (observer's) Forced Choice (of the child's) Preferential Looking (FPL).

We have constructed apparatus to measure visual acuity in preverbal infants by the FPL method and used it to measure binocular visual acuity in a series of infants. Forced choice preferential looking is a method which can be performed easily by orthoptists, offering the possibility of a new role for the orthoptic profession in the assessment of children with visual disorders.

MATERIALS AND METHODS

Our apparatus (described in detail elsewhere)[7] is an adaptation of that developed by Dobson *et al.*[8] The apparatus consists of a panel with two 9 cm portholes placed 36 cm apart (Figure 2). The infants responses are observed via a TV monitor (Figure 3). Photographically generated visual gratings are presented in a random manner through either porthole. The presentation of the gratings is controlled by a microprocessor. The operator selects the grating size to start the test procedure. The microprocessor keeps a score of the operator's performance and provides trial by trial feedback to the operator. When statistical significance is achieved for a particular grating the microprocessor terminates the test, prints out a trial by trial score of the test and commences the next test sequence.

A minimum of five and a maximum of 20 trials are used for each grating. It is assumed that if the infant fixates the grating in 75% or more of the trials it can resolve the grating.[8] A

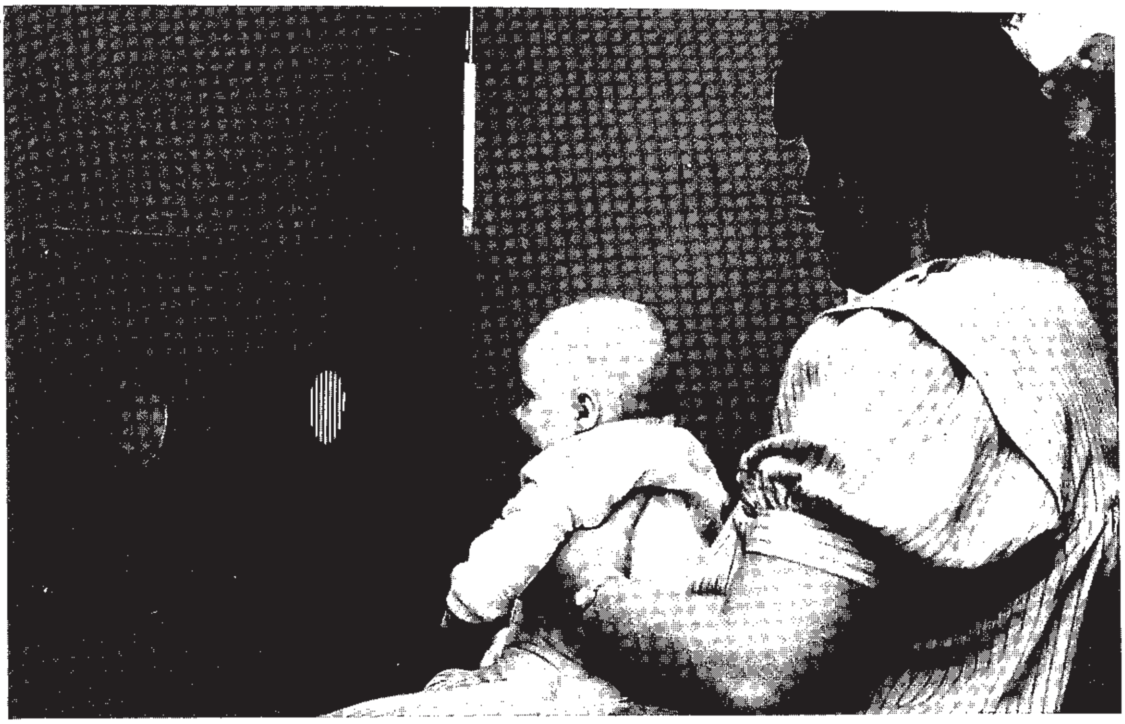

Figure 2: FPL apparatus showing a child fixating a grating displayed in the right porthole. Note the camera lens between the two portholes.

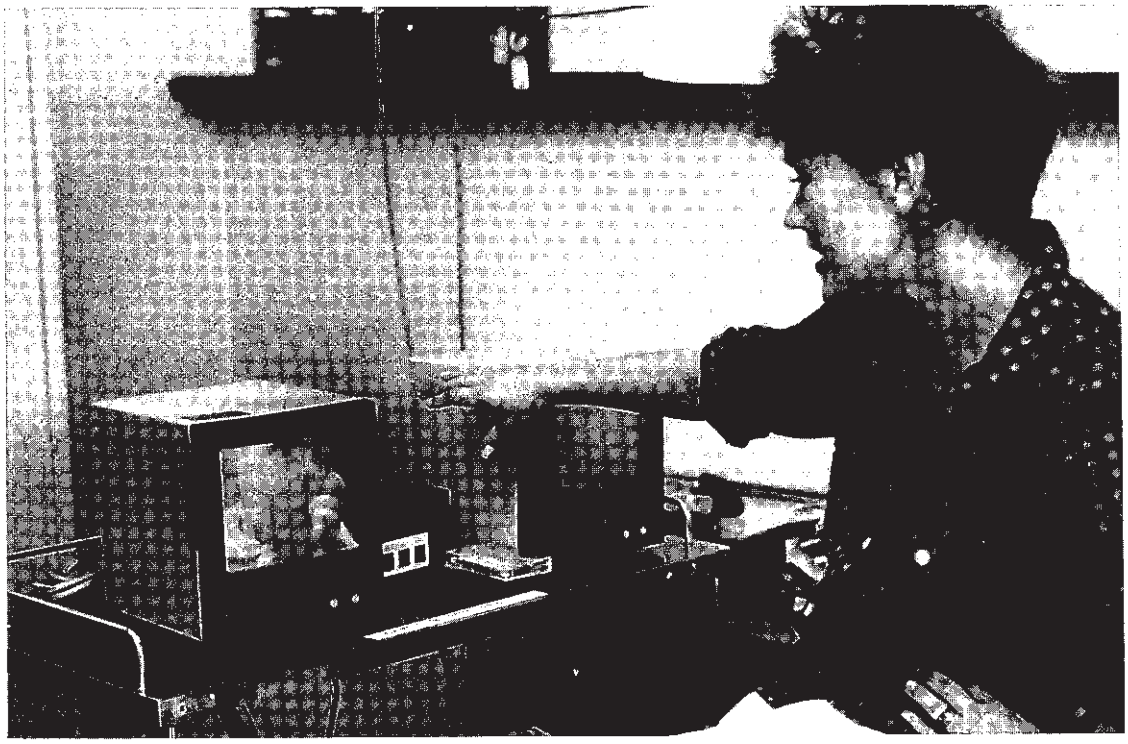

Figure 3: The observer judges the side on which the grating is displayed solely by the child's fixation preference seen on the TV monitor. The right hand TV monitor is used for programming purposes. The central panel between the monitors controls the apparatus *via* the microprocessor.

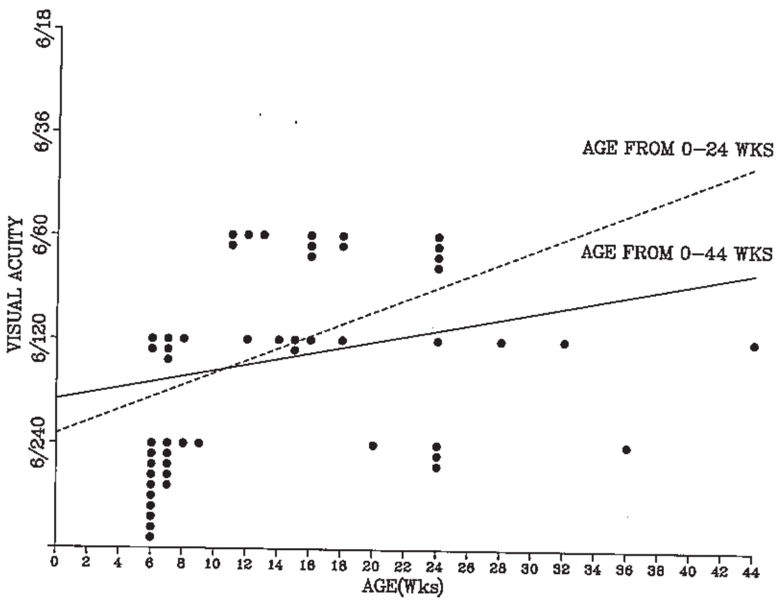

Figure 4: Binocular Visual Acuity In 51 Infants.

'staircase' testing procedure is used to enable rapid testing; i.e. each test sequence uses one grating size only. The staircase method is too time consuming to be done routinely by an ophthalmologist, therefore the role of observer is ideally suited to an orthoptist whose professional skills are well established in the assessment of infant visual behaviour.

The infant is tested with sequences of progressively smaller grating size until the acuity has been determined. In our apparatus we use gratings of 0.75, 1.5, 3, 5 and 12 cyc/deg corresponding to the Snellen acuities of 6/240, 6/120, 6/60, 6/36 and 6/18 respectively. The finest grating with which the child achieves statistical significance is taken to estimate the child's acuity. The test has been done binocularly in developmental studies but can be done monocularly to detect differences in acuity between the two eyes in infants with ocular disease.[6,9]

RESULTS

Sixty-three infants ranging in age from six weeks to 11 months have been tested. Overall we obtained a result in 51 babies (81%). The majority (31) were six to eight week old babies attending the well baby clinic for their six week postnatal checkup. The majority (22/31) of the six to eight week old babies were able to resolve a 0.75 cyc/deg grating corresponding to a Snellen acuity of 6/240 at the test distance of 35 cm. The remaining six babies in this age group resolved a grating of 1.5 cyc/deg (6/120). The data are presented in Figure 4. The test sequence usually took less than 10 minutes to complete. The main reason for failure was sleepiness on the part of the child in the younger age group. Babies over 6 months of age were too easily distracted to complete reliably the test within the time constraints imposed. The data from these older children is included in the table for completeness although there were only four children tested older than six months.

DISCUSSION

The assessment of visual performance in infants below six months of age is a common clinical problem. In our relatively inexperienced hands we have been able to use FPL to establish the binocular visual acuity in babies six weeks to six months of age. Our results in this age range show a progressive improvement in visual acuity from six weeks to six months of age and are similar to those published elsewhere.[10] The apparent decline in acuity which we observed after six months of age we attribute to a lack of attentiveness on the child's part. The rapid improvement in visual acuity in the first six months of life (possibly due to retinal maturation) is followed by a plateau which lasts for several months. The next improvement in visual acuity which begins at about 10 months of age is then attributed to cortical maturation.[12] Whatever the explanation, older babies do poorly with the conventional FPL technique and their attention must be maintained by a stimulus-reward system in order to obtain useful results.[11]

The advantage of the FPL method is that it is non-invasive and does not require highly technical skills for its performance. As orthoptists are by the very nature of their work already familiar with work involving babies, the necessary skill for them to act as the observer comes easily. Our apparatus was designed to be 'user friendly'; all that is necessary to activate the apparatus is to load the program into the computer and start the test sequence.

The disadvantages of the FPL method are that it requires some cooperation on the part of the child (e.g. the child must be awake), and that it is usually a binocular test. These disadvantages must both be addressed. First, the state of the child's arousal is crucial. The period just after a feed before the child goes to sleep or the period just after awakening before hunger supervenes are the best times for testing. Our success rate is not much lower than that reported by others (usually of the order of 90%)[8] despite the fact that we set ourselves the task of testing the children on a tight schedule (15 minute appointments) so as to mimic the busy clinic situation. A child untestable on one occasion can always be brought back for another appointment or alternatively can be settled down in an adjacent room and retested later.

Testing monocularly can be easily achieved either by using a ping pong ball cut in half[13] as an occluder or by using a translucent patch since most infants object to being occluded by an opaque patch. A precise measurement of an infant's monocular visual acuity is particularly useful in the management of eye diseases where the eyes may be satisfactorily aligned preventing easy assessment of the child's fixation preference (e.g. congenital cataracts or anisometropia). In the immediate postoperative period it would be very useful to have a precise measure of the acuity in each eye to assess the appropriateness of patching and of a particular power contact lens. We do not have a great deal of experience with monocular use as yet but we are encouraged by our experience to date.

Even when used binocularly FPL has proved useful in the assessment of children with suspected poor sight or blindness and helps in the assessment of children with developmental delay thought to be due to poor vision.[9] FPL is too cumbersome for use as a screening tool; other methods such as photorefraction are more appropriate. Nonetheless, it should come to play a role in the assessment of individual patients with specific problems such as aphakia. Its role as a research tool for investigating normal visual development in the first few months of life by such means has influenced clinicians towards earlier intervention in such conditions as congenital cataract because it is now well accepted that a successful outcome depends on treatment within the critical period of visual development.[14]

This method is worthy of investigation especially in those teaching hospitals which train orthoptists. The orthoptic profession has an opportunity to expand its role in children's eye care by investigating this technique and its possible uses.

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References

1. Dobson V, Teller DY. Visual acuity in human infants. A review and comparison of behavioural and electrophysiological studies. Vis Res 1978; 18: 1469-1483.
2. Atkinson J, Braddick O. Assessment of vision in infants. Trans Ophthalmol Soc UK 1979; 99: 338-343.
3. Fulton AB, Manning KA, Dobson V. A behavioural method for efficient screening of visual acuity in young infants. II. Clinical application. Invest Ophthalmol Vis Sci 1978; 17: 1151-1157.
4. Miranda SB, Hack M, Fantz RL, Fanaroff AA, Klauss MN. Neonatal pattern vision: A prediction of future mental performance? J Pediatr 1977; 91: 642-647.
5. Lennerstrand G, Axelsson A, Andersson G. Visual acuity testing with preferential looking in mental retardation. Acta Ophthalmol 1983; 61: 624-633.
6. Mohindra I, Held R. Visual acuity of infants with ocular diseases. Am J Ophthalmol 1982; 93: 198-209.
7. Gole GA, Coster DJ. A microprocessor-driven, one operator forced choice preferential looking apparatus. Aust J Ophthalmol. In press.
8. Dobson V, Teller DY, Lee CP, Wade B. A behavioural method for the efficient screening of visual acuity in young infants. I. Preliminary laboratory development. Invest Ophthalmol Vis Sci 1978; 17: 1142-1150.
9. Atkinson J, Braddick O, Pimm-Smith E. Preferential looking for monocular and binocular visual acuity testing of infants. Br J Ophthalmol 1982; 66: 264-268.
10. Gwiazda J, Brill S, Mohendra I, Held R. Preferential looking acuity in infants from two to fifty-eight weeks of age. Am J Optom Physiol Optics 1980; 57: 428-432.
11. Mayer DL, Dobson V. Visual acuity development in infants and young children as assessed by operant preferential looking. Vis Res 1982; 22: 1141-1151.
12. Bauer J, Birch EE, Gwiazda J, Shimojo S, Held R. A plateau in the development of grating acuity in human infants during the first year of life. Invest Ophthalmol Vis Sci 1984; 25 (3) (Suppl): 219.
13. Flynn JT. Discussion of presentation by Dr. Anne B. Fulton, et al. Ophthalmol 1979; 86: 440-441.
14. Gelbart SS, Hoyt CS, Jastrebski G, Marg E. Long-term visual results in bilateral congenital cataracts. Am J Ophthalmol 1982; 93: 615-621.