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Research Report

Use of a Structured Observation to Evaluate Visual Behavior in Young Children

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When assessing the visual function of young children, it is important to use a variety of tests. It is essential to have a structured observation method when it is not possible to use ordinary acuity tests. We have found that current visual acuity tests can be used only with children whose mental age is higher than about 24–30 months. Grating acuity tests, performed with the preferential looking procedure, can be used with very young children but give unreliable results in comparison with optotype acuity (Rydberg, Ericson,

Lennerstrand, Jacobson, & Lindstedt, 1999). It is therefore urgent to find a reliable method for testing visual function in children who are younger than 2 years old.

The behavior of a child is based on visual impressions from the first day of his or her life. This fact is the key to behavioral observations as a basis for appraising visual capability and is one reason why it is essential to identify children with visual impairments (that is, those who are blind or have low vision) as soon as possible after birth and to estimate the extent of their visual impairments.

A structured observation method can be created by using a checklist. An ideal checklist should be handy and reliable and include a minimum of observations. The checklist should give relevant information about visual function and help identify children with visual impairments. A checklist of this type was constructed by one of the authors (Lindstedt, 1994, 1997) for controlled observation of visual behavior. This checklist has been used for more than 20 years and has proved valuable, particularly for assessing young visually impaired children with or without additional impairments.

The participants in the study reported here were sighted children and children with visual impairments that were due to ocular disease but who had no other impairments. The results of appraising vision by use of

the checklist were compared with the results of the evaluations with other vision tests: (1) grating acuity and contrast-detection ability, for which tests can be used with children aged 2 and younger, and (2) optotype acuity tests for distance, which is the measure used by the World Health Organization for classifying visual impairment.

The aim of the comparison was to determine whether the result obtained by the checklist placed a child in the correct "level of vision" that corresponded to that obtained with other tests and at what age it is possible to use the checklist. Some preliminary results from this study were reported previously (Ericson, Rydberg, & Lindstedt, 1998).

Method

Participants

The study included 63 children who were observed using the checklist: 36 children with visual impairments that were due to ocular disease and 27 sighted children. The children did not have any known neurological deficits. The children with visual impairments ranged in age from 7 to 75 months (median 26 months); 14 were aged 18 months or younger. The sighted children ranged in age from 21⁄2 weeks to 83 months (median 21 months); 12 were aged 18 months or younger.

Materials

The checklist includes objects or tasks from daily activities that require different visual capabilities, such as a teddy bear or a doll, raisins, "hundred and thousands"or candy sprinkles on a wooden background, and large-print and small details in pictures. The visual behavior (that is, if the child appears to see an object) of the child in the test situation indicates the child's visual ability. The results from the checklist place the child into one of four different levels of vision, each of which corresponds to a certain range of visual acuity: (1) 20/2000–20/400 (0.01–0.05), (2) > 20/400–20/200 (> 0.05–0.1), (3) > 20/200–20/65 (> 0.1–0.3), or (4) > 20/65 (> 0.3) (see Figure 1).

Recognition acuity (optotype acuity) was tested for distance with the HVOT test (Hedin, Nyman, & Derouet, 1980) and/or the LH line test (Hyvärinen, Näsinen, & Laurinen, 1980) and the LH single-symbols and/or BUST single-symbols test (Lindstedt, 1988). The HVOT test consists of four letters in sizes from 20/200 to 20/20 at 9 feet (3 meters). The distance between the letters is always the same as the width of the letters in all lines. The LH test consists of four symbols (a heart, ball, house, and square) in sizes from 20/200 to 20/10 (0.1 to 2.0) at 9 feet (3 meters). In this test, the distance between the symbols is also the same as the width of the letters. The BUST test is a single-symbol test and consists of two pairs of pictures (fork/

spoon and scissors/eyeglasses) in nine sizes that are equivalent to a visual acuity of 20/300 (0.07) to 20/17 (1.2) at 9 feet (3 meters).

Resolution acuity (grating acuity) was tested with the "preferential looking method" (Teller Acuity Cards, TAC) (Teller, McDonald, Preston, Sebris, & Dobson, 1986). This test consists of 16 gray rectangular cards: 1 that is blank and 15 that have square-wave gratings. The grating density (spatial frequencies) changes between cards in steps of half an octave, from 0.28 cycles per centimeter to 40 cycles per centimeter.

Contrast detection was assessed for near vision using black sugar strands and white sugar strands on a black background and a white background. The exact size and spatial frequencies are difficult to define with these test objects, as are the contrast levels.

Procedures

The checklist. The objects were shown at a distance of 1.5 feet (0.5 meter) if not otherwise noted in the checklist (see ≈ 1). The visual behavior of the younger children was observed, while the older children usually named the objects. The larger objects for Level 1 were shown first, and then smaller objects for Level 2 to Level 4 were shown. The limit of visual ability was reached when no object in a level could be seen.

The HVOT and LH-tests. The HVOT and LH tests (line

and single) were performed at 9 feet (3 meters). If the largest optotype was not seen at this distance, the chart was moved to a closer distance where the child could recognize the optotype. If the child could not name the letters and symbols, a matching chart was used.

The BUST-test. This test was also used at 9 feet (3 meters). If the child could not see the largest letter at the required distance, the picture was moved closer until the child recognized it. Both objects in the pair (scissors/eyeglasses or fork/spoon) should be seen for the acuity value to be regarded as correct.

Teller Acuity Cards. These cards were used at a distance of 15 or 32 inches (38 or 55 centimeters). The card with the largest gratings was first presented to the child, and then progressively finer gratings were shown. On the basis of the child's looking behavior, the observer decided whether the child saw or did not see the grating.

Contrast detection. Contrast detection was tested with black sugar strands and white sugar strands on a white background and a black background. The test distance at which the child could detect the object was recorded, and the difference in distance between high contrast (white on black and black on white) and low contrast (white on white and black on black) was judged by the child's ability to fixate on the target and pick it up. The distance at which the object could be detected was the quantitative measure in the test. It varied between 4

and 30 inches (10 and 75 centimeters). If the difference for detecting the object between low- and high-contrast condition was more than 2 inches (5 centimeters), the child was considered to have impaired contrast vision.

Results

The two youngest visually impaired children, who were 7 months old, could be observed with the checklist. The youngest sighted child who was observed with the checklist was 2 1⁄2 weeks. According to their ability to cooperate or not to cooperate in testing with optotypes, the children were divided into two groups: Group 1 (recognition acuity)—the children who could be tested with optotypes—and Group 2 (resolution acuity)—the children who could not be tested with optotypes but were tested with grating acuity.

Recognition acuity

Group 1A. Of the 36 children with visual impairments, 16 could be tested with recognition acuity tests. Of the 16, 8 children could be tested with a linear test (the youngest child was 36 months), and 8 could be tested only with a single-symbol test (the youngest child was 24 months). Only 1 child had a recognition acuity that was lower than the level of vision attained by the checklist appraisal. Four children had higher recognition acuities, and 11 children had recognition acuities that corresponded to their level of vision (see

Figure 2).

Group 1B. Of the 27 sighted children, 13 could be tested with recognition acuity tests, 9 with linear optotypes (the youngest child tested was 29 months) and 4 only with single optotypes (the youngest was 21 months). Only 1 child (aged 29 months) had a recognition acuity that was slightly lower than the level of vision when tested with a linear test. Three children had recognition acuities (single optotypes) that were higher than their level of vision, and 9 children had recognition acuities that corresponded to their level of vision (see Figure 3).

Resolution acuity

Group 2A. Of the 36 children with visual impairments, 20 could be assessed with grating acuity but not with recognition acuity. Ten children who were tested with grating acuity had a resolution acuity corresponding to their level of vision; 1 child had a grating acuity that was lower than the level of vision and 9 children had grating acuities that were higher (see Figure 4).

Group 2B. Of the 27 sighted children, 14 could be assessed only with grating acuity. Seven had resolution acuities that corresponded to their level of vision. One child had a grating acuity that was lower, and 6 had grating acuities that were higher than their level of vision (see Figure 5).

The results showed a good correspondence (69%) between the appraised level of vision obtained from the checklist and the results of visual acuity tested with recognition acuity (letters and symbols). However, when the children's vision was tested with resolution acuity (grating acuity), nearly 50% of the children had better values than obtained when observed by the checklist. It is known that resolution acuity overestimates recognition acuity (Rydberg et al., 1999).

When the children's contrast-detection ability with black sugar strands and white sugar strands on a white background and a black background was compared with the results from the checklist, no agreement was found. The children with visual impairments and difficulty in contrast detection were distributed in all four levels of vision. No sighted children in Levels 3 and 4 had difficulty with contrast detection. However, 50% of the children in Level 1 (visual acuity 20/2000–20/400 (0.01–0.05) and Level 2 (visual acuity > 20/400–20/200 (> 0.05– 0.1) had difficulty. These children were all younger than 24 months.

An interesting finding was the development of contrast-detection ability in the sighted children and the children with visual impairments. The improved ability with age in detecting black sugar strands on a black background and white sugar strands on a white background was clearly demonstrated (see Figure 6). Most of the children (both those who were sighted and

those who were visually impaired) who were younger than 1½ years had difficulty detecting low contrast (black sugar strands on a black background and white sugar strands on a white background). However among the children who were older than 48 months, only the children with visual impairments had difficulty seeing white sugar strands on a white background (< 80%).

Discussion and conclusions

The checklist should be used in situations in which no established acuity tests can be used. We found good agreement between the appraised level of vision obtained by using the checklist and the results of visual acuity tested with recognition acuity (letters and symbols).

For the children with low vision, there was no agreement between the results obtained with the checklist and the tests of contrast detection. In sighted children, contrast-detection ability develops during the first years of life. Therefore, the younger sighted children could have had difficulty with contrast detection, but they all fell within the typical level of vision according to their age.

The checklist does not overestimate visual acuity in comparison with grating acuity and recognition acuity, and hence there is a minimal risk of giving parents unrealistic information and expectations about their children's visual ability with its results. It is easy to use

the checklist with young children who cannot be assessed with letters or symbols. We found that sighted children aged 10 months and younger reached Level 1, and children up to 18 months reached Level 2. Sighted children who were older than 24 months could reach Level 4, which is the typical level in the development of vision.

The results of this study enhance our previous clinical experience that the checklist is a good observation test for detecting children's visual ability when recognition acuity cannot be assessed because of age or mental capacity (Rydberg & Ericson 1998; Rydberg et al., 1999). It is also a good complement to testing with acuity cards.

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