Pediatric examination: Examination expecteds at various age levels

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Abstract
A video tape was made to visually demonstrate pediatric examinations of various age levels in order to aid the optometry student in acquiring clinical knowledge. Examination expecteds for ages 3-4, 5-6, 7-9, 10-12 years are listed. Also included are possible examination sequences and symptoms of visual difficulties demonstrated by children.

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PEDiatric examination: examination expecteds
at various age levels

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I. ABSTRACT

A video tape was made to visually demonstrate pediatric examinations of various age levels in order to aid the optometry student in acquiring clinical knowledge.

Examination expecteds for ages 3-4, 5-6, 7-9, 10-12 years are listed. Also included are possible examination sequences and symptoms of visual difficulties demonstrated by children.
II. INTRODUCTION

When performing a pediatric examination it is important to closely watch for behaviors and "tell-tale" signs which could point to potential visual deficiencies. Indications of visual problems do not come from the patient alone, but rather from the parents, teachers, and referring professional. Also, quantitative analysis of visual performance must be used in conjunction with qualitative evaluation and close observation. Using and integrating expected optometric performance, based on developmental age levels, with quantitative and qualitative analyses, will increase accuracy of visual diagnosis.

This paper will cover two major areas: 1) Quantitative visual assessment based on developmental age level; 2) Qualitative visual assessment. These two basic areas need to be addressed in order to fully explore possible visual difficulties. Without addressing the developmental, educational, and social background of the young patient the optometrist runs a greater risk of misdiagnosis.

A video tape designed to be used as a teaching tool to expressly demonstrate visual skills of various age group children was made. It is important to not only have a didactic knowledge of pediatric examination expecteds, but, also to be able to know clinically if the tests results are normal or anomalous. The video tapes were
geared for demonstrating clinically what is expected of various age groups of children.

III. METHOD:

A. Video Tape: On several occasions during the Fall of 1982 and Spring of 1983, there was video taping of children's examinations at the Pacific University Optometry School. The children examined were arbitrarily chosen, so that some of the filming was of normal responders and some of anomalous responders. A complete examination was performed on each child. There was one student, Terrie Leitner; and two professors, Paul Kohl and Norman Stern, who actually performed the examination. Involved in video taping was Girard Gibbons, Brian Priarson, and Sandy Coutts. The children were aware that they were being video taped, but, to reduce self-consciousness taping was done through a two-way mirror.

Visual screenings, affiliated with Pacific University Optometry School, were video taped by Brian Priarson and Sandy Coutts in the Fall of 1982 and Spring of 1983. The children video taped were arbitrarily chosen. The visual skills video taped were the usual visual screening tests. Also, included were isolated video tapings of interesting individual cases. The
children were fully aware of being video taped as they were tested directly in front of the camera. The testing was done by Sandy Coutts and Brian Piearson.

B. Literature Search and Paper: A literature search was made in the Fall of 1982 and Spring of 1983. A compilation of this information lead to the writing of this paper during the Fall of 1983.

IV. OPTOMETRIC EXAMINATION GEARED FOR CHILDREN

A. Need for Specializing the Examination:

1. Need for a Child's Examination:

   The scope of optometric care encompasses a great many specialties including low vision, contact lenses, and vision therapy. Another specialty, but one which is less well defined would be the area of children's vision care. Vision is an essential part of normal development, it is not an area which can be overlooked. Most practitioners realize this, but do not know how to efficiently assess visual performance. Instead they treat children as simply miniature adults. There are problems one faces when trying to treat children as miniature adults. A child cannot be expected to respond either quantitatively or qualitatively as an adult. Consequently, optometric techniques geared for
particular developmental age groups need to be used to evaluate visual development and performance.

Visual asthenopia and anomalous visual development will be manifested in ways which are dissimilar to adults. Depending upon verbal skills and psychosocial development a child may or may not be able to voice his/her visual difficulties. The child may be unaware of a visual problem or, the parents/teachers may not recognize signs of visually induced problems. It is necessary for the practitioner to carefully watch and assess verbal and non-verbal indicators, as well as, know expected optometric performance for various ages of children.

2. Need for Special Techniques-
When assessing the visual performance of any patient, there are certain areas which must be included. These are: 1) Refractive status; 2) Accommodative and convergence facility; 3) Visual perceptual skills; 4) Visual-perceptual-motor skills; 5) Eye movement skills; 6) Gross and fine motor skills; and 7) Qualitative assessment of the patient's visual status and developmental level.

The methods by which this information is attained will vary depending upon the patient's age,
maturity level, communication skills, and visual/motor/perceptual problems.

As an example, determining the range of single binocular vision on a four-year-old using a phoropter, would be nearly impossible. Yet, such information would be quite valuable. Using an out-of-phoropter estimate with loose prisms, such information could be attained.

A swift, continuous examination flow will increase a child's attention span and cooperation. Therefore, the results of the examination will be more valid, according to a study done by Eskridge (1973).

With a discontinuous examination sequence, the child is given a prime opportunity to be non-cooperative. Keeping the interest level high, using fun tests, given in an orderly, swift fashion, will greatly facilitate accurate patient responses.

3. Need for Establishing a Range of Normal Responses Which Vary by Age Group-

As with any test results, the expected population distribution will approximate a bell-shaped curve. It follows then, that a range of normalcy must be
established in order to determine an anomalous response. The particular range of normalcy will vary depending upon the patients' stage of development. When examining young patients, it would be beneficial to know the range of expected results for each age group, (stage of development) for each category of tests. The categories of tests which will be covered include: 1) accommodation, 2) convergence, 3) binocularity/fusion, 4) visual-perceptual skills, 5) visual-perceptual-motor skills.

B. Quantitative and Qualitative Examination Fundings:

1. Actual Expecteds Based on Literature Search—
a. Ages 3-4 years

1) Accommodation:
   a) 12.0-14.00 D of accommodative facility;
   b) Using a dangled bell patient will follow into about 4" and out about 3/4 of the distance.
   c) Book retinoscopy will show against motion of -.25 to -1.00 D.
   d) Patient should be able to clear +2.00 D at nearpoint.

2) Convergence:
   a) Will unequally grasp a target when fatigued.
b) Can convergence using a penlight 3"-6" from the nose.
c) Should be able to fuse 4° B1/B0 at near.

3) Eye Movements:
a) Dangle bell pursuits will show:
   1 - In horizontal meridion pursuits are fairly good as he/she sustains fixation on the bell.
   2 - In other meridions, a three-year-old follows about 1/2 cycle and then releases fixation.
   3 - Patient follows upward better than downward.
   4 - Quite a bit of head movement is present.

b) Penlight pursuits will show:
   1 - Follows fairly accurately and can touch with index finger.
   2 - Patient follows better in the horizontal and vertical meridions than circularly.
   3 - Head movement aids in accomplishing task.
c) Binocular eye movements will be poorer than monocular eye movements when fatigued.

4) Binocularity/Fusion:
   a) Stereofly: should get positive response, 1 1/2" for pinching wings.
   b) Wirt Stereotest:
      1 - Average is 30-50%
      2 - Superior is 50-70%
   c) Red lens: diplopia should not be present but will occur with fatigue.
   d) Pupillary reactions:
      3 years: Binocular pupillary change; no monocular change.
      3 1/2 years: Unstable binocular change; may or may not show erratic monocular change.
      4 years: Smooth binocular pupillary change, no monocular change.
   e) Hirschberg: should be centered, steady, and equal.

5) Visual-Perceptual Motor:
   a) Rides tricycle using pedals
   b) Alternates feet going up stairs
   c) Can stand on one foot momentarily
   d) Draws: circle, imitates cross and incomplete cross
   e) Colors, but outside of lines
f) See Table V for tests to assess patient's performance level.

6) Visual-Perceptual:
   a) Should be able to do a 4-5 piece jigsaw puzzle;
   b) Draws a circle;
   c) Draws a vertical and diagonal cross;
   d) Beginning to learn directionality;
   e) Deploys hands without direct supervision of eyes (three years). By four visual discrimination is much improved.
   f) See Table V for tests to assess patient's performance level.

b. Ages 5-6 years

1) Accommodation:
   a) 12-14+ D of accommodative facility.
   b) Should be able to clear ± 2.00D at near point.
   c) Using a dangled bell this age group will be able to sustain fixation, without difficulty to within 3" follow by an easy release to the examiner. Patients will gently touch bell accurately.
   d) Book retinoscopy will show low plus but frequently shows against from -.25D to -.75D
2) **Convergence:**
   a) Patient should be able to fuse 6 B1 - 6B0.
   b) Both eyes accurately converge on a target.
   c) Should no longer experience intermittent diplopia with fatigue.

3) **Eye Movements:**
   a) Dangled bell pursuits will show:
      1 - Horizontal and vertical meridions are better than the 3-4 year-old, fairly smooth and accurate.
      2 - In diagonal meridions pursuits will be wobbly or stair step fashion.
      3 - Head movement is no longer required to aid in eye movements.
      4 - OD = OS = OU
   b) Penlight pursuits will:
      1 - Horizontal and vertical pursuits are good; diagonal pursuits are performed in a stair step manner.
      2 - Head movement is not used to aid pursuit.

4) **Binocularity/Fusion:**
   a) Stereofly: positive response; wings pinched at about 1" - 1 1/2". Upon
reversal, most five year olds will verbalize its location behind the card.

b) Wirt Stereotest: Score of 60% or better.

c) Pupillary reactions: Smooth, continuous binocular, pupillary change; no monocular change.

d) Red lens: Reports mixture of colors. No fatigue or diplopia should be noted.

e) Hirschberg: Should be equal, centered and steady.

f) Stereoacuity should be 140" to 100".

5) Visual-Perceptual Motor-

a) Draws triangle

b) Draws diagonal cross

c) Can catch 9 1/2" ball 2 out of 3 times.

d) Rhythmic activities (e.g., ball bouncing) are achieved.

e) Copying tasks are less laborious.

f) Fair ability to print block letters.

g) Draws recognizable man, body and extremities.

h) See Table V for tests to assess performance level.

6) Visual-Perceptual:

a) Should be able to do a 6-7 piece jigsaw puzzle.
b) Still learning directionality, but basics are pretty good (e.g., shoes on correct feet, picks up pencil with one hand each time).

c) Know the difference between various shapes (circle vs. square).

d) Visual discrimination alone can guide hand movement.

e) See Table V for list of test to assess patients performance level.

c. Ages 7-9

1) Accommodation:
   a) 12.00 - 14.00D of accommodation
   b) Should be able to clear ± 2.00 D at near point; 12 cycles/min.
   c) Book retinoscopy will show low against -.25 to -.75D.
   d) Range of positive and negative relative accommodation should each be greater than ± 1.75D.
   e) See examination expecteds for 5.5 and 6 year olds. Table I.

2) Convergence:
   a) Both eyes should converge accurately and to the same degree.
   b) Hirschberg should be steady and equal.
c) Near point of convergence should be less than 5 cm/8 cm.

d) Findings indicating difficulties include:

1 - Phoria at distance greater or less than 0-2 exophoria.

2 - Phoria at near greater or less than 0-6 exophoria.

3 - Distance vergence ranges:
   - Base out to blur - less than 7 prism diopters
   - Break of less than 15 diopters
   - Recovery of less than 8 prism diopters
   - Base in to Break of less than 5 prism diopters
   - Recovery of less than 3 prism diopters

4 - Near Vergence Ranges:
   - Base out to blur less than 14 prism diopters
   - Break less than 18 prism diopters
   - Recovery less than 7 prism diopters
   - Base in blur less than 11 prism diopters
   - Break less than 19 prism diopters
   - Recovery less than 10 prism diopters
5 - Opposing vergence blur should be twice the phoria.

6 - A manifest fixation disparity of any amount.

7 - Flipper prisms with 4 Base in and 8 Base out lenses at distance and 8 Base in and 12 Base out at near. The prisms are utilized as in the accommodative flipper test and the patient views a 20/30 line of print. Eight-ten cycles/min. are expected.

e) See examination expecteds for 5.5 and 6 year olds. Table I.

3) Eye Movements

a) Pursuits in the vertical and horizontal meridians are only slightly superior to diagonal medions.

b) Monocular and binocular eye movements should be equal; OD = OS = OU.

c) If an inaccurate eye movement is made it frequently is an overshoot.

d) Reach, grasp, and release is good.

4) Binocularity/Fusion

a) Positive and negative convergence near and far are lower than the population.
expected. (See examination expecteds for 5.5 and 6 year olds and 10-14 year olds, Tables I & II).

b) Red lens - should report one; 1/2 white and 1/2 red.

c) A normal Worth - 4 Dot response is expected.

d) Stereoacuity should be 60".

4) Visual-Perceptual Motor

a) Draws a diagonal cross

b) Draws a diamond vertical and horizontal

c) Draws a divided rectangle

d) Preference for pencils over crayons

e) See Table V for list of tests to check if child is performing up to age level.

5) Visual-Perceptual

a) Size constancy becoming more consistent

b) Perspective is developing as constant.

c) Concepts turning from strictly concrete to more abstract.

d) Directionality correct 80% of the time.

e) Comparative size of humans is more accurate.

f) See Table V to see if child is performing up to age level.

d. Ages 10-12 years:
1) Accommodation
   a) Should be able to clear ± 2.00D at near; 12-16 cycles/minute.
   b) Positive and negative relative accommodation should each be greater than ± 1.75D.
   c) MEM-Retinoscopy should have a lag of less than or equal .75D.
   d) See examination expecteds for 5.5 and 6 year olds. Table II.

2) Convergence:
   a) Both eyes should converge accurately and to the same degree.
   b) Hirschberg should be steady and equal.
   c) Near point of convergence should be less than 5 cm/8cm.
   d) Findings indicating difficulties include:
      1 - Phoria at distance greater or less than 0-2 exophoria.
      2 - Phoria at near greater or less than 0-6 exophoria.
      3 - Distance vergence ranges:
         Base out to blur - less than 7 prism diopters
         Break of less than 15 diopters
         Recovery of less than 8 prism diopters
Base in to Break of less than 5 prism diopters

Recovery of less than 3 prism diopters

4 - Near Vergence Ranges:

Base out to blur less than 14 prism diopters

Break less than 18 prism diopters

Recovery less than 7 prism diopters

Base in blur less than 11 prism diopters

Break less than 19 prism diopters

Recovery less than 10 prism diopters

5 - Opposing vergence blur should be twice the phoria

6 - A manifest fixation disparity of any amount.

7 - Flipper prisms with 4 Base in and 8 Base out lenses at distance and 8 Base in and 12 Base out at near. The prisms are utilized as in the accommodative flipper test and the patient views a 20/30 line of print. Eight-ten cycles/min. are expected.

e) See examination expecteds for 10-14 year olds. Table II.
3) Eye Movements
   a) Pursuits are good in all meridians, vertical, horizontal and oblique.
   b) Saccades are smooth, and fairly accurate. Small under- and over-shoots present.
   c) Right eye alone, left eye alone, both eyes together should all perform equally, OD = OS = OU.
   d) Reach, grasp, and release good in all meridions.

4) Binocularity/Fusion
   a) Good stable binocular vision with stereopsis.
   b) Stereoacuity should be 40" or better.
   c) Normal Worth - 4-Dot response.
   d) Normal red lens response.
   e) See Table II for examination expecteds for 10-14 year olds.

5) Visual-Perceptual Motor
   a) Mature, mechanically correct pattern in motor activities.
   b) Good rythmicity present.
   c) Good motor control.
   d) Handwriting and written work neat and fairly consistant.
e) Able to copy from blackboard without much trouble.

6) Visual Perceptual
   a) Can discriminate small differences and likenesses.
   b) Able to read for concepts.
   c) Able to visualize directions.
   d) Rarely confuses directionality.
   e) Able to spell and recite from memory.
   f) Able to organize assignments into basic steps.

References (1), (2), (3), (4), (5), (6), (7)

2. Qualitative Assessment Leading to Visual Diagnosis:

The qualitative analysis of a child's optometric examination is incomplete without taking non-numeric and non-verbal measures into account. There are many non-verbal physical and behavioral clues which point to visually induced problems. A practitioner needs to be alert to such signals which are important if proper vision care is to be instituted.

When examining a child, it is of the utmost importance to make qualitative assessments of: 1) The visual performance in the environment, 2) the physical and social developments, 3) the child/
parent relationship, and 4) the communication skills.

Qualitative visual assessment begins as soon as the patient walks through the office door. It is important for the practitioner to consciously ask him or herself several questions at this point and make numerous evaluations.

1. What is the general appearance of the patient? Is the patient clean or dirty, meticulous or slovenly? If the patient is wearing glasses are they clean and old or dirty and new. Are they well used for the age of the spectacles?

2. Does the patient appear visual? As the patient plays with toys and looks around does he/she use visually guided behavior. If the patient is reading a book while in the waiting room note if head movement and a finger pointing are needed to keep from loosing his place.

3. How is the child/parent rapport? Are they verbal with one another? Do they seem to get along well?

4. Is the child communicative and sociable? Does the child communicate and socialize well with other children or siblings in the waiting room. Or, is the child shy and introverted.
5. Does the patient have any overt medical/physical problems?

Does the child seem to be crippled, deaf, obese or have any other health problems? Could any of the health problems be hereditary?

a. Note the patient's head, face and eyes. Is the head position as it should be? Watch for a head tilt or turn. Is the face symmetrical and the eye level? Are the eyes straight or strabismic? Are the lids open equally?

7. Note the patient's general coordination while walking to the examination room. How is their gross motor locomotion and bilaterality? Does the vision seem to lead motor planning?

During the examination the qualitative assessment should continue. In fact, as patient communication and rapport develops the more accurate patient evaluation becomes. The non-verbal observations to be made include:

1. Assessment of Communication Skills: Is the child verbal or non-verbal? Can the patient express ideas and experiences?

2. Assessment of Nearpoint Visual Skills: During tests which require reading or a nearpoint demand watch for several behaviors: a) finger
pointing, b) eyes turning in or out, c) confusion of letters consistently, d) normal working distance, e) squinting, f) head tilting or turning, g) subvocalization, h) head movement to track during reading.

3. Motivation Level: Are the parents and child motivated to improve visual performance.

4. Details of type of visual performance goals of the patient.

5. Does the child process visually over auditorily.

6. Does the child seem to have difficulty concentrating on one task.

7. Is the attention span short for the age and task?

a. Behaviors which are indicative of visual problems:

When a patient is having visual difficulties there are characteristic signs and behaviors which are evident. Typically these behaviors compensate for the system or systems which are responsible for the problem.

1. Symptoms of eye movement difficulties:

   a) head turns while reading across page
   b) lose place while reading
   c) need a finger or marker to keep place.
   d) short attention span especially while doing nearpoint work, e.g., reading, copying.
2. Symptoms of Accommodative Dysfunction:
   a) poor attention span especially while reading
   b) slow reader, but learned to read as fast as other children
   c) difficulty copying from blackboard onto paper at desk
   d) asthenopia at near associated with rubbing of eyes
   e) periodic blurring at distance after near point activities or blurring at near
   f) excessive fatigue at the end of the day
   g) reports headaches and/or sleepiness after reading.

3. Symptoms of Convergence Dysfunction:
   a) letters and words swimming
   b) complaints of double vision
   c) misorientation of drawings on a page
   d) asthenopia near and/or far
4. Symptoms of Binocular Fusion Difficulties

a) complaints of diplopia in any position of gaze
b) repeats letters within words
c) omits letters, numbers of phrases
d) misaligns digits in columns
e) squints, closes, or covers one eye
f) head tilt or turn
g) consistently poor postural deviation during desk work
h) patient reports one eye not as good as other
i) turns head other than straight ahead for clearest image
j) poor depth perception
k) words swimming together while reading
l) difficulty in tracking sports

5. Symptoms of Visual-Perceptual-Motor Problems

a) left/right reversal
b) top/bottom (above/below)
c) difficulty discriminating various shapes, e.g., b, d,
d) poor handwriting
e) poor eye/head coordination
f) misaligns vertical and horizontal series of numbers or letters
g) improper pencil grasp
h) needs multiple fixations to copy a picture (form-triangle)
i) assignments full of erasures
j) are shapes "correct", i.e., parallel lines parallel, closure adequate, size contancy maintained.

6. Symptoms of Visual Perception Problems
a. Symptoms of Visual Form Perception Problems
   1. mistake words with same or similar beginnings.
   2. fails to recognize same word in next sentence
   3. reverse letters and/or words in writing or copying
   4. confuses likeness and minor differences
   5. repeatedly confuses words with similar beginnings and endings of words
   6. fails to visualize what is read or heard
7. whispers to self while reading silently
8. returns to "drawing with finger" to differentiate like and different
9. poor reading comprehension
10. poor ability to remember what is read
11. inadequate sight vocabulary

b. Symptoms of General Visual Perceptual Problems:

1. Difficulties with gross motor and bilateral integration.
   a) poor coordination
   b) difficulties with rhythmic activities
   c) cannot sit still
   d) tendency to be "one-side" dominant

2. Difficulty with directionality:
   a) right/left reversal
   b) difficulty learning right versus left

3. Poor figure/ground discrimination
   a) poor awareness of what is important to attend to
   b) incompletion of work or excessive attention to details

4. Poor visualization abilities
   a) difficulty visualizing what is read or heard
   b) poor comprehension
   c) difficulty learning new material
d) difficulty in anticipation of next step

e) tends to subvocalize when reading silently.

5. Poor auditory memory and discrimination

6. Poor visual/auditory integration

C. Tests and Examination Formats which Geared for Efficient Pediatric Evaluation:

It is of the utmost importance when examining a child to be as time efficient as possible since a child's attention and cooperation span is often short. It is necessary then to have a well thought out examination sequence so as to attain the greatest amount of information in the least amount of time. The tests to be used need to be prioritized so that is problem oriented. A thorough case history from the parents and teacher will aid in this procedure. Also, cementing the necessary tests and their order will significantly aid the examination flow.

1. Case History:

A thorough case history is necessary on every patient and, the young patient is no exception. The case history is basically divided into two separate portions. Firstly, one which is a written evaluation by the parents and teacher, preferably completed prior to the examination. Secondly, one which is oral, taken during the actual examina-
tion. Input from all these sources will help to illicit visual problems early in the examination. A teacher sees the patient in class where he/she notes a problem with letter reversal, poor handwriting, and poor visual comprehensive. The parent may notice a motivational problem toward academics, blaming the problem on interest or other non-visually oriented cause. The patient might explain that he/she does not like to use one eye sometimes and gets headaches. These are three different perspectives all pointing to the same answer, but, in and of themselves will not give a full clinical picture.

a. Case History Directed to the patient:
   1) How do you like school?
   2) What subjects do you like?
   3) What happens when you read?
      a) Do words blur, break into two, swim together?
      b) Do you get a headache from reading?
      c) How long are you able to read without eye strain? How is the strain relieved? Aspirin, sleep.
      d) Is it difficult to keep your place while reading?
   4) Do you like one eye better than the other?
5) If patient wears or used to wear glasses, find out from the patient's perspective if he/she liked them, and, where and how much they were used.

6) How do you think you are doing in school?

7) Is your vision ever blurry? If so, when.

8) Are you satisfied with your present visual performance, or do you think you have a problem?

9) How do you do in sports?

10) Do you feel you keep up with your fellow students in school and sports?

b. Case History Directed to the Parents:

1) How does your child do in school?

2) Does he/she seem to enjoy school?

3) Does your child ever complain of: headaches, double vision, bluriness near or far?

4) Does your child seem to enjoy coloring, reading, or other near work? Or, does he/she avoid doing such tasks.

5) Does your child get sleepy after tasks listed above?

6) Do you ever notice one of the eyes wandering in or out?
7) Has your child ever worn prescription glasses? If so:
   a: 1) when were they prescribed; 2) were they worn?
   b: Did they seem to aid the child's performance. Why are they not worn now?
8) Does the child enjoy and do well in sports?

c. Case History Directed Toward the Teacher:
   1) What is the child's attitude toward school?
   2) What subjects does the patient do well? Poorly?
   3) Is the child performing up to his/her grade level in subjects difficult for him/her?
   4) Is the child hyper or hypoactive?
   5) How does the child do in sports and recess?
   6) Does the child hear and follow oral directions well?
   7) Does the child follow written directions well?
   8) Is the child able to conceptualize as well as his/her peers?
   9) During class work do you describe the child as having:
      a) poor reading comprehension
      b) frequent letter and direction reversals
      c) decreased attention span
d) use of fingers or marker as a pointer

e) avoids reading and near work

f) frequently rubs eyes

g) closes or covers one eye

h) holds head too close to desk when reading or writing

i) skips words or sentences

j) rereads lines or phrases

k) work substitution

l) reads too slowly

m) says words aloud or moves lips

n) unusual fatigue or restlessness after visual concentration

o) complaints of words or letters "running together"

p) complaints of distance or near blur

q) poor eye-hand coordination

r) moving head back and forth while looking at distant objects

s) excessive blinking

t) squinting

u) head movements while reading

v) tilting or turning head askew consistently

w) confuses likeness and minor differences

x) slowness in all schoolwork
y) one eye turns in or out at anytime
z) difficulty in finishing assignment

2. Examination Sequence:
   a. Example One -- All children
      1) Case History:
         a) Written portion from parents and teacher filled out prior to examination.
         b) Oral portion as first part of sequence during exam time.
      2) Visual Acuity:
         a) Take the visual acuity in the 3-5 age group.
            1) Tumbling E
            2) Landolt C's
            3) Preschool graded activity chart
            4) Acuity candies
            5) Cover one eye
            *6) VER
            *7) OKN
            8) Point to similar larger target
         b) Take the visual acuity in the 6-9 age group by:
            1) Snellin acuity
            2) Tumbling E
            3) Landolt C's
4) Preschool graded activity chart
5) VER
6) OKN

*For use on patients not able to respond due to lowered acuity potential, slow learner, or incooperation.

c) Take the visual acuity in the 10–12 year age groups by:
   1) Snellen acuity

*2) Tumbling E
   3) Landolt C

*4) VER

*5) OKN

3. Refractive Error Estimation
   a) VA's
   b) Ophthalmoscopic lens
   c) Keratometry reading
   d) Reaction to plus and minus lens
   e) Retinoscopy
      1) cycloplegic
      2) manifest
      3) dark room
   f) Automatic refractor

4. Accommodation:
   a) Pupil response to lens rock and distance rock
b) Donders push-up

c) Near retinoscopy

5. Eye Movements:
   a) Pursuits/Saccades/Rotations
      Vary target depending upon attention
      level of the child.
   b) Fixation tests

6. Binocularity/Fusion
   a) Eyes appear straight
   b) Hirschberg
   c) Cover test
   d) Cover/uncover/recovery
   e) Luster Red/Green
   f) Physiological diplopia
   h) Red/green and light
   i) Loose vertical prism
   j) Stereo fly

7. Ocular Health
   a) External
   b) Pupillary reactions
   c) Ophthalmoscopy
   d) Neratomy
   e) Confrontation fields
   f) Color

Reference: (8)
8. Visual Perception
   a) Form discrimination
   b) Figure/Ground
   c) Visual Closure
   d) Visual Direction
   e) Visual Memory
   f) Visualization

9. Visual Perceptual Motor
   a) Gross motor
   b) Fine Motor

10. Sensory Integration

b. Example Two:

1. For ages 3 - 5 1/2 years
   a) Case history
   b) External examination using a penlight
   c) Cover Tests (cover/uncover/recovery using thumbs on hand)
   d) Pupillary reactions
   e) Stereo tests
   f) Mirror-Pola test if suppression is suspected.
   g) Six prism diopters and/or red glass tests for evidence of binocular vision
   h) Amigo Red Plak Test for phorias.
   i) Retinoscopy - status with cartoon slides; dynamic and dark room.
j) Visual Acuity using illiterate "E", Ffook's cube or familiar object chart.
k) Astigmatism (try to keratometry with larger child if retinoscopy indicates it)
l) Ophthalmoscopy
m) Parent Consultation

2) For ages 5 1/2 years and older)

Note: Intersperse case history questions amongst other procedures.
a) Titmus fly and Wirt circles; combine with Mirror-Pola if suppression is suspected
b) Eye movement control and motility: monocular rotation rotations and versions, binocular versions, convergence amplitude and flexibility/fatigue, saccades, includes near cover test.
c) External examination including pupillary reactions.
d) Ophthalmoscopy including fixation evaluation.
e) Habitual phorias at near.
f) Vision and visual acuity; letter names or sounds, numbers, etc., according to child's ability.
g) Retinoscopy - dynamic and static 

h) Keratometry 

i) Subjective: balance of sphere if non-cyclopligic exam: cycloplegic refraction if called for. 

j) Induced phonia at distance 

k) Near analysis: e.g. cross cylinder, near ductions, plus and minus to blur and blur-out, AC/A ratio 

l) Parental Consultation: explanation should stress quality of visual performance and type of therapy to best attain good vision.
VI. SUMMARY

On several occasions children's visual abilities were video taped. The tapes were made to be used as a teaching instrument to aid the student of optometry in gaining clinical knowledge.

A review of the pediatric examination was made. There is a need for specializing optometric techniques and visual findings for children. Children respond quantitatively and qualitatively different than adults, consequently requiring evaluation geared for the age of the patient examined. Lists were made of expected visual performances.
### TABLE I

**Examination Expecteds for 5.5 and 6 Year Olds**

<table>
<thead>
<tr>
<th>5-6 Years</th>
<th>5.5 Years</th>
</tr>
</thead>
<tbody>
<tr>
<td>F.G.</td>
<td>Shepard</td>
</tr>
<tr>
<td>.5 eso</td>
<td>1 xo</td>
</tr>
<tr>
<td>17.7</td>
<td>21</td>
</tr>
<tr>
<td>5.2</td>
<td>9</td>
</tr>
<tr>
<td>8.5</td>
<td>9</td>
</tr>
<tr>
<td>2.4</td>
<td>4</td>
</tr>
<tr>
<td>4.1 xo</td>
<td>5 xo</td>
</tr>
<tr>
<td>+ .84D</td>
<td>+ .25</td>
</tr>
<tr>
<td>22.0</td>
<td>25</td>
</tr>
<tr>
<td>5.7</td>
<td>13</td>
</tr>
<tr>
<td>20.7</td>
<td>20</td>
</tr>
<tr>
<td>8.7</td>
<td>11</td>
</tr>
<tr>
<td>-3.62 med</td>
<td>-2.37</td>
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<tr>
<td>+2.50</td>
<td>+1.75</td>
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**FINDINGS**

<table>
<thead>
<tr>
<th>#8</th>
<th>10-14 1/2</th>
<th>M</th>
<th>S.D.</th>
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<tr>
<td>.19 xo</td>
<td>52 exo</td>
<td>2.10</td>
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<tr>
<td>#10BK</td>
<td>21.2</td>
<td>19.2</td>
<td>6.9</td>
</tr>
<tr>
<td>#10R</td>
<td>7.19</td>
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<tr>
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<td>#11R</td>
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<td>#13B</td>
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<td>5.5 exo</td>
<td>4.35</td>
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<td>#14B-P</td>
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<td>#16BK</td>
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<td>6.8</td>
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<tr>
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<td>#21NET</td>
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<tr>
<td>#21-P</td>
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### TABLE II

**Examination Expecteds for 10-14 1/2 and 11 Year Olds**

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<th>11 Years</th>
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<td>21.2</td>
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<td>7.10</td>
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<td>3.29</td>
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<tr>
<td>2.8 xo</td>
</tr>
<tr>
<td>+1.00D*</td>
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<tr>
<td>21.66</td>
</tr>
<tr>
<td>6.4</td>
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<tr>
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<td>-3.76</td>
</tr>
<tr>
<td>+2.16D</td>
</tr>
<tr>
<td>+2.41</td>
</tr>
</tbody>
</table>

**NPC Data 4**

<p>| 2.5&quot; | 1.47 | N.P.C.-3K |
| 4.5&quot; | 2.38 | N.P.C. R  |</p>
<table>
<thead>
<tr>
<th>Age Group</th>
<th>0 - 4</th>
<th>5 - 9</th>
<th>10 - 14</th>
<th>15 - 19</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>#</td>
<td>%</td>
<td>#</td>
<td>%</td>
<td>#</td>
</tr>
<tr>
<td>Population 1973</td>
<td>18,359</td>
<td>(100)</td>
<td>18,022</td>
<td>(100)</td>
<td>20,651</td>
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</table>

**Vision Problems**

- **Visual Acuity**
  - 734 (4)
  - 1,081 (6)
  - 1,859 (9)
  - 3,695 (18)
  - 7,369 (10)

- **Amblyopia**
  - 367 (2)
  - 360 (2)
  - 413 (2)
  - 411 (2)
  - 1,551 (2)

- **Refractive Error**
  - **Myopia**
    - 184 (1)
    - 541 (3)
    - 2,478 (12)
    - 3,489 (17)
    - 6,692 (9)
  - **Hyperopia**
    - 1,285 (7)
    - 1,081 (6)
    - 1,239 (6)
    - 1,232 (6)
    - 4,837 (6)
  - **Astigmatism**
    - 367 (2)
    - 541 (3)
    - 620 (3)
    - 616 (3)
    - 2,144 (3)
  - **Anisometropia**
    - 367 (2)
    - 541 (3)
    - 826 (4)
    - 1,026 (5)
    - 2,760 (4)

**Coordination Problems**

- **Squint**
  - 734 (4)
  - 721 (4)
  - 826 (4)
  - 821 (4)
  - 3,102 (4)
- **Esophoria**
  - 184 (1)
  - 360 (2)
  - 413 (2)
  - 411 (2)
  - 1,368 (2)
- **Exophoria**
  - 367 (2)
  - 541 (3)
  - 620 (3)
  - 616 (3)
  - 2,144 (3)
- **Hyperphoria**
  - ****
  - ****
  - ****
  - ****

**Organic Problems**

- **Congenital**
  - 184 (1)
  - 180 (1)
  - 207 (1)
  - 205 (1)
  - 776 (1)
- **Traumatic**
  - ****
  - ****
  - ****
  - ****
  - ****

**Performance Problems**

- **Vision Performance**
  - 918 (5)
  - 2,523 (14)
  - 4,337 (21)
  - 5,132 (25)
  - 12,910 (17)
- **Vision Development**
  - ?
  - 1,802 (10)
  - 2,478 (12)
  - 1,642 (8)
  - 5,922 (8)
- **Vision Perception**
  - ?
  - 721 (4)
  - 1,033 (5)
  - 821 (4)
  - 2,575 (3)

**Total Conditions**

- 5,875
- 11,173
- 17,556
- 20,322
- 54,926

**Total Children**

- 2,203 (12)
- 3,604 (20)
- 5,163 (25)
- 6,363 (31)
- 17,293 (22)

**Less than 0.5**

*Based on Estimated 1973 Population and Results of a Survey conducted by Henry B. Peters, O.D., M.A.*
**TABLE IV**

Titmus Stereotest Limits: Lower Limits of Stereoacuity on Titmus Stereotest, in Subjects with Normal Binocular Single Vision

<table>
<thead>
<tr>
<th>Age Group</th>
<th>Stereoacuity</th>
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</thead>
<tbody>
<tr>
<td>3 1/2 - 5</td>
<td>3000&quot;</td>
</tr>
<tr>
<td>5 - 5 1/2</td>
<td>140&quot;</td>
</tr>
<tr>
<td>5 1/2 - 6</td>
<td>100&quot;</td>
</tr>
<tr>
<td>6 - 7</td>
<td>80&quot;</td>
</tr>
<tr>
<td>7 - 9</td>
<td>60&quot;</td>
</tr>
<tr>
<td>Over 9</td>
<td>40&quot;</td>
</tr>
<tr>
<td>Perceptual Ability (Grade)</td>
<td>Visual Form</td>
</tr>
<tr>
<td>---------------------------</td>
<td>-------------</td>
</tr>
<tr>
<td>K-1 So. California Figure-Ground Visual Closure</td>
<td>Perceptual Speed (PMA)</td>
</tr>
<tr>
<td>2-4 So. California Figure-Ground Visual Closure</td>
<td>Perceptual Speed (PMA)</td>
</tr>
<tr>
<td>4-6 So. California Figure-Ground Visual Closure</td>
<td>Perceptual Speed (PMA)</td>
</tr>
<tr>
<td>7-9 So. California Figure-Ground Visual Organization</td>
<td>Perceptual Speed (MAS)</td>
</tr>
<tr>
<td>10-12 So. California Figure-Ground Visual Organization</td>
<td>Perceptual Speed (MAS)</td>
</tr>
</tbody>
</table>

**TABLE V**

Tests by Grade Level for Determining Perceptual Abilities
REFERENCES
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1. F. Adler, *Physiology of the Eye*: Mosby St. Louis, MO. 1983


4. H. Haynes, O.D., *Comparison of Selected Analytic Findings at Various Age Levels*: Visual Training Laboratory, Pacific University


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