REFRACTIONS FOR SCHOOL-AGE CHILDREN

Refracting school-age children is often difficult because they may have poor control of their accommodation. Furthermore, their limited ability to understand testing procedures and questions may make their responses unreliable. This chapter will outline different approaches in order to more successfully refract school-age children and come to more accurate prescriptions by utilising techniques that control their accommodation.

AIM

This unit teaches you how to successfully refract school-age children and young people.

LEARNING OUTCOMES

When you have worked through this unit you should be able to:

- discuss the importance of controlling accommodation when refracting children
- accurately refract children (5 to 15 year olds) and young people (15 to 30 year olds).

WHY REFRACT CHILDREN DIFFERENTLY THAN ADULTS?

Adults and children present different challenges (problems) during the refraction examination.

COMMON PROBLEMS WHEN REFRACTING ADULTS	• Refraction on older adults can be difficult if they have small pupils and/or changes inside their crystalline lens (including cataract). • Small pupils can make retinoscopy difficult for the examiner, and can also make it difficult for the person to tell the examiner which lens looks clearer during subjective refraction. • Lens changes and cataracts make retinoscopy difficult for the examiner and, if the VA is affected by the lens changes, the refraction can be less accurate.
COMMON PROBLEMS WHEN REFRACTING CHILDREN	• For children, the challenge of refraction is not small pupils or lens changes, as most children have large pupils and clear crystalline lenses. • For children, the challenge is to control accommodation. • If the examiner does not control accommodation properly, the child's accommodation may cause the measurement of their refractive error to be incorrect. • If spectacles are prescribed with this incorrect measurement, the child may initially be happy with the clarity (clearness) of their vision, but will become unhappy with the comfort of their vision. • Even worse, you may encourage the child's eyes to develop in the wrong way, leading to strabismus (turned eye), amblyopia (lazy eye) or worsening refractive error! If a child accommodates during a refraction: • myopic prescriptions will be too strong - causing sore eyes, headaches, strabismus and/or encouraging more myopia to develop. • hyperopic prescriptions will not be strong enough - so the refractive error will not be corrected properly, and problems such as strabismus and amblyopia may not be addressed. • iIt may look like the child has astigmatism - even if this is not really the case. The best way to control accommodation is to use the techniques described in this unit. If you control accommodation well, you will be more likely to get an accurate refraction when you refract children (and even some adults).

MEASURING VISUAL ACUITY FOR CHILDREN

This section outlines how to make the measurement of visual acuity (VA) in children more accurate.

MATCH THE VA TEST TO THE CHILD'S AGE

- **Birth to 6 months of age**
  - It is difficult to measure the VA of babies' eyes in normal eye clinics.
  - At some specialist eye clinics electrophysiological tests can be done. These tests measure changes in brain signals when a baby looks at a visual target.

- **6 months to 2.5 years of age**
  - It is still difficult to measure VA in this age group in normal eye clinics.
  - At some specialist eye clinics, preferential looking tests can be done which measure VA by watching which of two targets a child chooses to look at. These specialist eye clinics sometimes also use electrophysiological tests to measure changes in brain signals when a child looks at a visual target.

- **2.5 years to reading age (before the child learns to read)**
  - Symbol charts (such as the Lea Chart, Patti Pics, or Allen Pics) are the easiest to use.
  - Directional shape charts (such as the Tumbling E or Landolt C Charts) are sometimes possible.
  - Matching charts (such as the HOTV Chart or Sheridan-Gardner Test) are accurate but harder to use than symbol charts.

- **Reading age – adult**
  - If a child can read, they can use the same VA charts as adults.

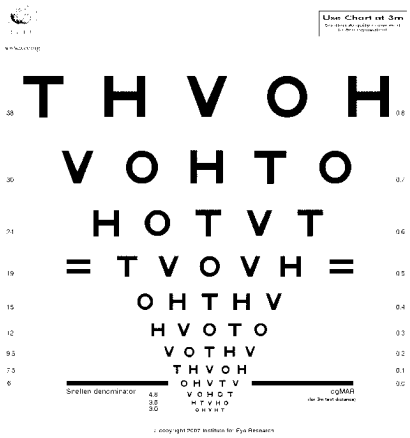

***Figure x.1**: The HOTV chart*

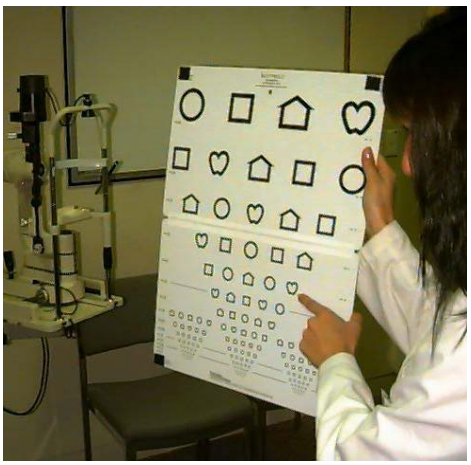

***Figure x.2**: The Lea symbol chart*

MEASURING VISUAL ACUITY FOR CHILDREN (CONT.)

USE AN APPROPRIATE TEST FORMAT

Symbols, directional shapes and letters can all be presented in Single-Symbol, Single-Line, or LogMAR formats. Each format has advantages and disadvantages.

- Single-Symbol test format presents only one object on an otherwise blank page. If the child gets three consecutive pages of the same size correct, you change to a smaller size. If the child gets one or more pages wrong, you change to a larger size. The child's VA is the smallest size for which they get all three pages correct. Single-Symbol is the easiest format for children to complete because there is nothing to confuse or distract them. However, it gives the least accurate information on visual function because children with vision disorders (especially amblyopia) can perform the test surprisingly well. This is misleading because most things in the real world are not separated from the things surrounding them. Single-Symbol acuity is not a good description of how a child will function in the world.

- Single-Line test format presents one line of objects (five symbols, directional shapes or letters in a row, all of the same size). If the child gets more than half the line correct, you change to a smaller line; if the child gets more than half the line incorrect, you change to a larger line. The child's VA is the smallest line which they get more than half correct. Single-Line format is a useful compromise between Single-Symbol and LogMAR formats.

- LogMAR format presents a full chart of objects (symbols, directional shapes or letters). VA is determined in the way you use for adults. It is the most difficult format for children to complete because there are so many things on the page to distract them from the one object they are supposed to be naming at any one point in time. However, it does give the most accurate information on visual function, because the space between objects on a LogMAR chart provides constant contour interaction across the chart. The contour interaction design makes children with vision disorders (especially amblyopia) perform poorly, providing an accurate representation of how these children function in the real world.

Contour Interaction describes the way that objects next to each other are resolved into two separate objects by a person looking at them. The amount of interaction depends on the size of the objects as well as the distance between them. LogMAR charts maintain constant contour interaction by giving one object of space between objects at all points on the chart. This is useful for quantifying visual function in people with vision disorders because some vision disorders (especially amblyopia) affect contour interaction. Conditions that increase a person's contour interaction are said to cause the "crowding phenomenon". The crowding phenomenon makes Single-Symbol acuity an extremely poor description of real-world visual function for people with vision disorders.

MEASURING VISUAL ACUITY FOR CHILDREN (CONT.)

LET THE CHILD RESPOND IN A WAY THEY FEEL COMFORTABLE	Some children find it: • easier to say their responses (most children as long as appropriate symbols, such as the Lea symbols, are used); • easier to show the direction of a symbol (a few children); • easier to point to a matching letter or symbol (a few children). The best VA charts for young children allow responses to be said or pointed to (such as the Lea Chart) – whatever the child prefers.
USE AN APPROPRIATE TEST DISTANCE	The test distance that you use for a child will depend on what sort of VA charts you have and how the child responds. • It is easiest to relax a child's accommodation in a 6 metre room, but many children are more likely to attend to the test if the chart is closer. • A chart that is reflected in a mirror can make it harder for children to control their accommodation, creating variable (changing) VA measurements.
PERFORM VA TESTS IN AN AGE APPROPRIATE ORDER	• First: measure binocular distance VA. • Second: measure monocular distance VA (right then left eye). This test order is useful for two reasons: - Binocular VA is usually easier and slightly better than the monocular VAs. If the child does a good job reading the VA chart they will feel more confident and happier during your examination. Children (even more than adults) get anxious when unable to perform at their best. - Children are more likely to relax their accommodation during binocular VA testing. This is partly because they are less anxious and partly because they can see more of the room when both eyes are open. • Third: measure near VA. - Although children cannot have presbyopia, their accommodation skills can vary. If a child has poor accommodation skills, they will not see clearly at near even if they have good distance vision. - Note that N5 is not equivalent to 6/6. Near VA cards for children should go down to N2 (such as the near Lea LogMAR chart).
KNOW WHAT RESULTS YOU EXPECT TO GET	Children are not born with adult visual capacities. It is thought that newborn infants have acuities between about 6/120 and 6/95. This is thought to improve to between about 6/24 and 6/18 by 1 year of age. By the time children are able to respond to recognition VA tasks (such as symbols, directional shapes or letter matching) at 2.5 years of age, their visual systems have almost adult-like vision capacities. However, the difficulties of measuring the VA of children means that you can be satisfied with the following VA levels for ages: • 6/15 for 2.5 years of age • 6/12 for 3 years of age • 6/9.5 for 4 years of age • 6/7.5 for 5 years of age • 6/6 for 6 years of age Differences between the right eye and left eye of the same child are more important than these estimations of appropriate visual development. For example, measurements of binocular 6/7.5, R 6/7.5, L 6/15 for a 3-year-old child should make you more suspicious of a vision problem than measurements of binocular 6/15, R 6/15, L 6/15.

ADAPTING ADULT REFRACTION METHODS FOR USE ON CHILDREN

It can be more difficult to get a useful answer when refracting a child than when refracting an adult. Simply asking the child to choose the clearest lens will usually give you an unhelpful answer.

Tests will not provide useful information unless a child attends to (concentrates on) the task that they must do for the test. Even objective tests (such as retinoscopy) require the child to focus on something.

Most children do not find letters as interesting to look at as pictures. Depending on cultural issues, some young children will not even concentrate on pictures. Instead they need large, colourful, noisy, interesting toys – these are called fixation tools. The picture or toy used should have something detailed to focus on (to hold the child's accommodation) for retinoscopy. Consider the "one toy, one look" rule: retinoscopy will often need two toys, one for each eye.

Figure x.3: *Examples of fixation tools*

ADAPTING ADULT REFRACTION METHODS FOR USE ON CHILDREN (CONT.)

This section outlines extra things that require consideration, if the examiner wants to use adult refraction methods on a child.

RETINOSCOPY	• Do not expect a child to fixate on a letter chart while you perform retinoscopy. Keep the child fixating by using something more interesting. This could be an interesting picture, or preferably a real object that interests the child. • The fixation target should be held (or preferably moved) in an interesting way, at a distance of 6 metres (or as far away as possible if it is a smaller room or the child only shows interest in closer objects). • Leave room lights on. - While it is necessary to turn lights off when you perform retinoscopy on older adults (who might have small pupils and opacities in their crystalline lens) it is unnecessary for most children. - Leaving room lights on improves the child's side vision (which decreases their anxiety and helps some children to maintain control of their accommodation). • Use full-aperture trial lenses in a trial frame. - Half aperture trial lenses (and phoropters) restrict side vision. • Have realistic expectations for what the binocular working distance lenses (fogging lenses) will do for you. - Working distance lenses are needed so that you do not have to hold your retinoscope at infinity, but they will not necessarily relax a child's accommodation.
SUBJECTIVE REFRACTION	Many children are unable to make *any* properly considered subjective decisions - and no child will be able to do this for a long period of time. This means that relying on children's answers to give you a full subjective refraction is likely to give you the wrong answer. It is better to only use subjective refraction to: • refine the cylindrical part of astigmatic corrections and/or • conduct a binocular balance. **There are three main reasons why true subjective answers are difficult to get from children:** **1. Children are adaptable – they get used to things that have changed so quickly that they cannot tell which change was better.** **2. Children are impressionable – they pick up on cues (hints) from adults and give answers they think adults want to hear.** **3. Children cannot control their accommodation – there will be a range of lenses they can see clearly with (but only one that will be best for their long-term visual health).**

ADAPTING ADULT REFRACTION METHODS FOR USE ON CHILDREN (CONT.)

SUBJECTIVE REFRACTION (cont.)	• You should not use subjective refractive techniques to refine spherical powers when refracting children. But, if you have no other choice: • It is important to ask the child only whether the chart is: - "the same or worse" when adding plus lenses, and - "the same or better" when adding minus lenses. • Try to avoid over-minusing or under-plussing by trying not to encourage the child to accommodate: - if plus lenses do not make vision definitively worse: add more plus - if minus lenses do not make vision definitively better: do not add minus.

REFRACTION METHODS THAT WORK WITH CHILDREN

Several alternative refraction methods give better results when refracting children. These include:

- Blur Function
- Cycloplegic retinoscopy, and
- Mohindra retinoscopy.

The Blur Function method is described in more detail below.

BLUR FUNCTION REFRACTION	The aim of a Blur Function refraction is to determine the maximum plus (most hyperopic, least myopic) refraction under normal binocular conditions. This may be different to what feels clearest to the child in the examination room, or to what would be measured with drug-induced cycloplegia. However, the amount of plus found with Blur Function refraction is often a useful guide to the most appropriate prescription for a child. There are two types of Blur Function: the Standard Blur Function and the Modified Blur Function. The type of Blur Function that you choose to do depends on the child's unaided VAs and retinoscopy findings. The Standard Blur Function can be used if there is: • less than (or equal to) 3 lines difference between the unaided monocular VA of the right eye and the left eye; • less than (or equal to) 1.50 DS difference between the right and left eyes on retinoscopy. The Modified Blur Function can be used if there is: • more than 3 lines difference between the unaided monocular VAs of the right eye and the left eye; • more than 1.00 DS difference between the right and left eyes on retinoscopy.

REFRACTION METHODS THAT WORK WITH CHILDREN (CONT.)

BLUR FUNCTION REFRACTION (cont.)	*If a person has the same refractive error in each eye, it is called isometropia. If they have different refractive errors in each eye it is called anisometropia.*
STANDARD BLUR FUNCTION REFRACTION - METHOD	**Step 1:** Put two isometropic power lenses (R lens = L lens) into the trial frame. Choose the power of these lenses by adding +2.00 DS to the distance retinoscopy finding. If there are small differences between eyes or small astigmatisms, approximate using isometropic spheres. Only include cylindrical powers that are greater than –1.00 DC. ***Example*** If your retinoscopy results are R +1.50 DS and L +2.25 / –0.50 x 180, then put R=L +4.00 DS lenses into the trial frame. **Step 2**: Measure and record the distance binocular VA (the person is looking with both eyes) with these lenses. **Step 3**: If the VA is worse than 6/12: • change the lens power by –0.50 DS in each eye • record the distance binocular VA again. If the VA is better than 6/12 at this stage: • it means you had very poor control of accommodation during retinoscopy • change the lens power in +1.00 DS steps in each eye until VA is worse than 6/12 • record the distance binocular VA again. **Step 4**: Continue changing the lens powers in –0.50 DS steps while measuring and recording the distance binocular VA, until the VA is better than 6/12. Now change the lens powers in −0.25 DS steps while measuring and recording the distance binocular VA, until the VA is 6/7.5 or better (or until the VA reaches some other acuity and stops improving with each subsequent lens change). **Step 5:** Do a binocular balance with a rapid alternate cover: • ask “better one or two?” • add –0.25 DS to the worse eye and recheck balance. Continue adding minus to the worse eye until there is equality or reversal of which eye is better on binocular balance. Record the lens powers for each eye.

REFRACTION METHODS THAT WORK WITH CHILDREN (CONT.)

STANDARD BLUR FUNCTION REFRACTION – METHOD (cont.)	**Step 6:** Now change the lens powers binocularly in –0.25 DS steps, measuring and recording distance binocular VA with each change until "best vision" is reached. "Best vision" occurs when the same VA is measured with two consecutive lenses. "Best vision" is **NOT** the child's subjectively preferred lenses. The first lens pair that gives "best vision" is considered the Blur Function refraction.
STANDARD BLUR FUNCTION REFRACTION – PROBLEM SOLVING	• If binocular VA does not improve to the expected level: - you may have missed significant (>1.00 DC) astigmatism; - there may be bilateral amblyopia; or - there may be an eye health problem affecting VA. • Investigate these possibilities.
STANDARD BLUR FUNCTION REFRACTION – EXAMPLE 1	A child reports that she sometimes gets headaches and blurry vision, but that at other times she feels fine and her vision is good. Unaided VAs are: Binoc 6/12 R 6/9.5 L 6/15 Your retinoscopy measurements are: Right +3.00 DS Left +3.25 / –0.50 x 180 Since there is less than 3 lines unaided VA difference between the eyes, and less than 1.00 DS difference between the eyes on retinoscopy, it is appropriate to perform a Standard Blur Function refraction on this child. It is appropriate to use isometropic spheres since astigmatism is less than or equal to 1.00 DC. **Step 1:** Put R=L +5.00 DS lenses into the trial frame in front of both eyes. **Step 2:** Measure distance binocular VA with R=L +5.00 DS: $6/18^{+4}$ **Step 3:** The VA is worse than 6/12 so: • reduce the lens power by 0.50 DS for both eyes • measure binocular VA again. Distance binocular VA with R=L +4.50 DS is $6/9.5^{+1}$. **Step 4:** The binocular VA is now better than 6/12, so change the lens powers now in -0.25 DS steps. Distance binocular VA with R=L +4.25 DS is $6/7.5^{+3}$.

REFRACTION METHODS THAT WORK WITH CHILDREN (CONT.)

STANDARD BLUR FUNCTION REFRACTION – EXAMPLE 1 (cont.)

Step 5:
When VA reaches 6/7.5 or better (or stops improving at some other level with two successive lens changes), perform a binocular balance.

VA was better than 6/7.5 with R=L +4.25 DS.

With R=L +4.25 DS, the child was questioned regarding which eye was better while rapidly alternating cover from right to left eye. The left eye was found to see better.

With R +4.00 DS, L +4.25 DS, rapid alternating cover found that the left eye could still see better.

With R +3.75 DS, L +4.25 DS, rapid alternating cover found that the right eye could see better.

The balance reversed between 0.25 DS anisometropia and 0.50 DS anisometropia. Since it is preferable to keep the anisometropic component of a refraction as small as possible, binocular balance was recorded as R +4.00 DS, L +4.25 DS.

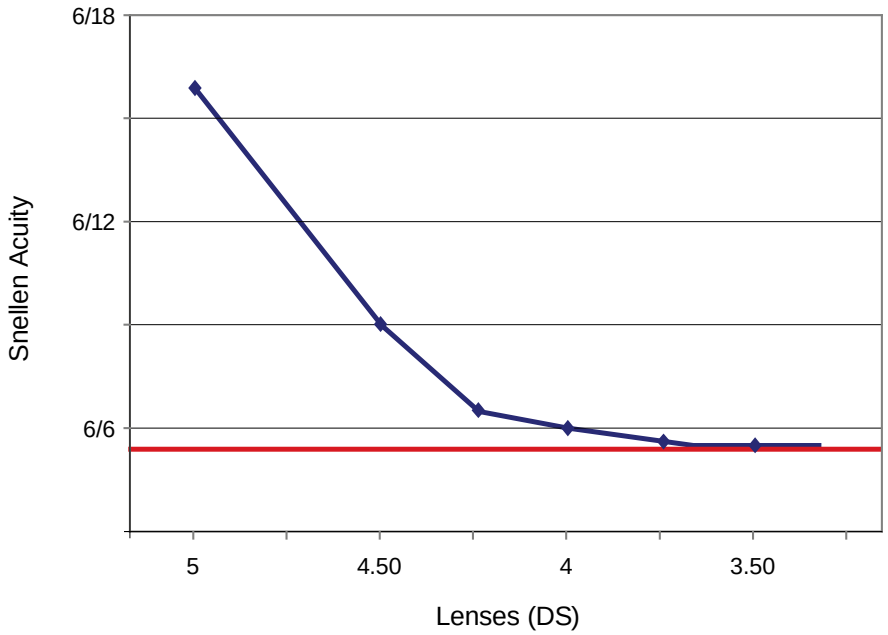

Figure x. 4: *The Blur Function graphed for Example 1*

Step 6:
Change lens power binocularly until "best vision" is achieved.
Distance binocular VA with R +4.00 D, L +4.25 D is 6/6.
Distance binocular VA with R +3.75 D, L +4.00 D is $6/4.8^{-2}$.
Distance binocular VA with R +3.50 D, L +3.75 D is $6/4.8^{-2}$.
The first lens pair that achieves "best vision" is R +3.75 D, L +4.00 D. This is the Blur Function result.

REFRACTION METHODS THAT WORK WITH CHILDREN (CONT.)

STANDARD BLUR FUNCTION REFRACTION – EXAMPLE 1 (cont.)	Comparing this Blur Function result to the retinoscopy result implies that the child was probably accommodating (by 0.75 DS R and L) while retinoscopy was being done. Also, the small astigmatism found in the left eye during retinoscopy was either real but too small to have any consequence, or was induced by deviation off the optical axis. Either way, the child is better off without the cylindrical power in their spectacles.
MODIFIED BLUR FUNCTION REFRACTION – METHOD	The Standard Blur Function refraction assumes VA is approximately equal between right and left eyes. If there are 3 or more lines of difference in unaided vision between eyes, or there is more than 1.50 D anisometropia on retinoscopy, the Modified Blur Function refraction is useful. **Step 1:** Perform Steps "a" to "d" below, which are similar to Steps 1 to 4 of the Standard Blur Function but without using isometropic lenses and without a binocular balance. Although your patient will have both eyes open, they are likely to only use their best eye (nearly always the one with the lower retinoscopy result and better unaided VA) during the measurements. a. Put the retinoscopy lenses plus 2.00 DS into the trial frame (right and left eye lens powers will probably be different). b. Measure and record the binocular distance VA with these lenses: - you can almost assume that the eye with the lower retinoscopy result and better unaided VA is the only eye contributing the VA measure, but if you want to check you can alternately cover each eye to check that this is the case - it is important to do Step 1 binocularly because, even though the worse eye is not directly contributing to the VA measure, it does contribute to accommodation control. c. If the VA is worse than 6/12: - change the lens power by –0.50 DS in both eyes - record the binocular distance VA again. If the VA is better than 6/12 at this stage: - you had very poor control of accommodation during retinoscopy - change the lens powers in +1.00 DS steps in both eyes until VA is worse than 6/12 - record the binocular distance VA again. d. Continue changing the lens power in –0.50 DS steps while measuring and recording the binocular distance VA, until the VA is better than 6/12. Now change the lens powers in –0.25 DS steps while measuring and recording the binocular distance VA, until the VA stops improving with two consecutive lens changes.

REFRACTION METHODS THAT WORK WITH CHILDREN (CONT.)

MODIFIED BLUR FUNCTION REFRACTION – METHOD (cont.)	e. The first lens that gives "best vision" is the Blur Function refraction for the better eye. **REMEMBER** "Best vision" occurs when the same VA is measured with two consecutive lenses. "Best vision" is **NOT** the child's subjectively preferred lenses. **Step 2**: Perform Steps "a" to "d" below, which are similar to Steps 1 to 4 of the Standard Blur Function but done monocularly for the eye with the worse VA and without a binocular balance. a. Prevent the better eye from seeing the chart and put the retinoscopy result plus 2.00 DS for the worse eye in the trial frame. It is best to use plus powered lenses to fog (make vision worse) the better eye, but sometimes you will need to use an occluder to stop it from seeing the chart. b. Measure and record the distance VA with these lenses for the worse eye. c. If the VA is worse than 6/12: - change the lens power by –0.50 DS in the worse eye - record the distance VA for the worse eye again. If the VA is better than 6/12 at this stage: - you had poor control of accommodation during retinoscopy - change the lens power in +1.00 DS steps in the better eye until VA is worse than 6/12 - record the distance VA for the worse eye again. d. Continue changing the lens power in –0.50 DS steps while measuring and recording the distance VA of the worse eye, until the VA is better than 6/12. Now change the lens powers in –0.25 DS steps while measuring and recording the distance VA of the worse eye, until the VA stops improving with two consecutive lens changes). e. The first lens that gives "best vision" is the Blur Function refraction for the worse eye.
MODIFIED BLUR FUNCTION REFRACTION – EXAMPLE 2	A child reports that he sometimes gets headaches and blurry vision. Unaided VAs are: Binoc 6/9.5 R 6/9.5 L 6/60. Your retinoscopy measurements are: Right +3.00 DS Left +5.25 / –0.50 x 180 Since there is 3 or more lines unaided VA difference between the eyes, and more than 1.50 DS retinoscopy difference between the eyes, it is appropriate to perform a Modified Blur Function refraction on this child.

REFRACTION METHODS THAT WORK WITH CHILDREN (CONT.)

MODIFIED BLUR FUNCTION REFRACTION – EXAMPLE 2 (cont.)	**Step 1:** a. Put R +5.00 DS and L +7.00 DS into the trial frame. b. Measure distance binocular VA with R +5.00 DS and L +7.00 DS: - $6/18^{+4}$ You can usually assume that only the right eye (best unaided VA and lower retinoscopy result) will contribute to this VA measure, but if you want to check you can alternately cover each eye to check that the right eye is better. c. The VA is worse than 6/12 so: - change the lens power by –0.50 DS for both eyes - measure binocular VA again. Distance binocular VA with R +4.50 DS, L +6.50 DS is $6/9.5^{+1}$. d. The binocular VA is now better than 6/12, so change the lens powers in –0.25 DS steps. Distance binocular VA with R +4.25 DS, L +6.25 DS is $6/7.5^{+3}$. Distance binocular VA with R +4.00 DS, L +6.00 DS is $6/6^{+1}$. Distance binocular VA with R +3.75 DS, L +5.75 DS is $6/6^{+1}$. e. The first lens that achieves “best vision” is the Blur Function for that eye. VA did not improve with R +3.75 DS, so R +4.00 DS is the Blur Function refraction for the right eye. **Step 2:** a. No amount of additional plus lens power was able to make the vision of the right eye worse than that of the left eye. So the right eye was occluded. b. Measure distance monocular VA with L +7.00 DS: - 6/120 c. The VA is worse than 6/12 so: - change the lens power by –0.50 DS for the worse eye - measure monocular VA again. Distance monocular VA with L +6.50 DS is 6/75. d. Continue changing the lens power in –0.50 DS steps while measuring and recording the distance VA of the worse eye, until the VA is better than 6/12. Then change the lens powers in –0.25 DS steps. Distance monocular VA with L +6.00 DS is $6/48^{-1}$. Distance monocular VA with L +5.50 DS is 6/30. Distance monocular VA with L +5.00 DS is 6/30.

REFRACTION METHODS THAT WORK WITH CHILDREN (CONT.)

MODIFIED BLUR FUNCTION REFRACTION – EXAMPLE 2 (cont.)	e. The first lens that achieves "best vision" is the Blur Function for that eye. VA did not improve with L +5.00 DS, so L +5.50 DS is the Blur Function refraction for the left eye. VA did not improve past 6/30. It is possible that this VA reduction is the result of significant uncorrected astigmatism, amblyopia or an eye health problem. It is important to find out which one is responsible. In this case, you would need to do further investigation in each area: • to find uncorrected astigmatism: - repeat retinoscopy or try cross-cylinder subjective refraction • to diagnose amblyopia or an eye health problem - complete (or refer for) a best-practice ocular health examination.

A Note on Astigmatism with Blur Function Refractions

If retinoscopy indicates significant astigmatism, and "best vision" from Blur Function is poor, there should be further investigation of astigmatism.

- Cross-cylinder subjective investigation of astigmatism is usually difficult before 8 to 10 years of age.
- Keratometry should be performed routinely when significant astigmatism is suspected. A keratometer is a machine that measures corneal curvature. Knowing corneal curvature is useful because childhood astigmatism is more often caused by the cornea than by the crystalline lens.
- Cycloplegic and Mohindra retinoscopy techniques can both be helpful in determining astigmatic corrections.

THE +1 TEST AND THE BLUR FUNCTION – WHAT'S THE DIFFERENCE?

The +1 Test and Blur Function refraction are different techniques that test for different things, although both are useful for refracting people who have active accommodation.

THE +1 TEST	• The +1 Test is a good way to make sure that the person's accommodation was relaxed during the refraction and that we have not given the person too much minus (or not enough plus). • The +1 Test is a refraction technique that is used *in combination with* a best vision sphere (BVS) or sphero-cylindrical refraction. • The +1 Test is done after the monocular BVS or sphero-cylindrical refraction: – distance binocular VA is measured with the BVS or sphero-cylindrical refraction lenses – two +1.00 D trial lenses are added to the trial frame (one in front of each eye) – distance binocular VA is measured with these extra +1.00 D trial lenses – the person's VA should be between 2 and 4 lines worse than the previous measurement – if it is not more than 2 lines worse, the person was accommodating during the BVS or sphero-cylindrical refraction → more plus must be added to both eyes to relax the accommodation. • If you discover that a person has been accommodating during the refraction, you must add more plus so that they will not be under-plussed (or over-minused) when you prescribe spectacles.
BLUR FUNCTION REFRACTION	• The Blur Function is a refraction technique that is useful for refracting children and young people. • The Blur Function technique is used *instead of* a BVS or sphero-cylindrical refraction. • A Blur Function refraction aims to find the maximum plus refraction under binocular conditions.

SUMMARY: REFRACTION FOR SCHOOL-AGE CHILDREN

WHY REFRACT CHILDREN DIFFERENTLY THAN ADULTS?

- Older adults can be difficult to refract if they can have small pupils and changes inside their crystalline lenses.
- Children are difficult to refract because they have active accommodation.
- If a child accommodates during a refraction:
  - myopic prescriptions will be too strong
  - hyperopic prescriptions will not be strong enough
  - it may look like the child has astigmatism (even if they do not really).

MEASURING VISUAL ACUITY FOR CHILDREN

- Use a VA chart that is appropriate for the child's age and development (such as a Lea symbol chart for 2.5 to 6 year olds).
- Use a chart with an appropriate format (preferably LogMAR, although remembering that single symbol charts are easier for children to do).
- Use the chart at the correct distance (preferably at 6 metres, although some children will be more likely to attend at closer distances).
- Conduct VA tests in an age appropriate order: binocular distance, R distance, L distance, binocular near.

ADAPTING ADULT REFRACTION METHODS FOR USE ON CHILDREN

- Retinoscopy:
  - Use a picture or a real object that interests the child for fixation.
  - Leave the room lights on.
  - Use full aperture trial lenses whenever possible.
- Subjective refraction:
  - Avoid adult subjective refraction techniques whenever possible.
  - If it is necessary, make it as fast as possible by getting the best objective starting point possible.
  - Only add minus lenses if minus power makes vision definitively better (do not change the lens if vision is "about the same").
  - Add plus lenses if plus power lenses do not make vision definitively worse (change the lens if vision is "about the same").

BLUR FUNCTION REFRACTION

- This is a refractive technique specifically designed for children.
- Purposely blur the retinoscopy finding with plus lenses, then find out the most plus or least minus that gives the "best vision". This is done by reducing plus power 0.50 D steps and measuring binocular distance VA at each step until best VA is reached.
- If VA does not reach an age-appropriate level using conventional retinoscopy and Blur Function, perform further investigation for potential astigmatism, amblyopia and eye health problems.

SUMMARY: REFRACTION FOR SCHOOL-AGE CHILDREN (CONT.)

+1 TEST & BLUR FUNCTION – WHAT'S THE DIFFERENCE?

- +1 Test and Blur function are different techniques that test for different things, although both are useful for refracting people who have active accommodation.
- The +1 Test is a good way to make sure that the person's accommodation was relaxed during the refraction.
- The Blur Function is a refraction technique that is useful for refracting children and young people.
- The +1 Test is done after a BVS or sphero-cylindrical refraction.
- A Blur Function refraction is done instead of a BVS or sphero-cylindrical refraction.

TEST YOURSELF QUESTIONS

1. Why should we refract children and adults in different ways?

_____

_____

2. How should we measure VA on a 4-year-old child?

_____

_____

3. Would you do a *Standard Blur Function* or a *Modified Blur Function* on a child who has unaided VA and retinoscopy results of R 6/30, –4.50 DS; L 6/19, –3.00 DS?

_____

4. What is the Blur Function refraction for a child who gives the following sequence of results?

Unaided VA:		**Binocular 6/48, R 6/60, L 6/60**		
Retinoscopy:		**R=L –3.25 / –0.50 x 180**		
Blur function:	**R = L**	**–1.50 D →**	**6/24**	
	R = L	**–2.00 D →**	**$6/12^{+}$**	**"better"**
	R = L	**–2.25 D →**	**$6/7.5^{-1}$**	**"better"**
	R = L	**–2.50 D →**	**$6/6^{-1}$**	**"better"**

Right eye sees clearer with alternating occlusion over -2.50 D for both eyes
Right eye sees clearer with alternating occlusion over R -2.50 D, L -2.75 D
Left eye sees clearer with alternating occlusion over R -2.50 D, L -3.00 D

R –2.50 D,	**L –2.75 D**	**→**	**6/6**	**"better"**
R –2.75 D,	**L –3.00 D**	**→**	**$6/6^{+2}$**	**"better"**
R –3.00 D,	**L –3.25 D**	**→**	**$6/6^{+2}$**	**"better"**
R –3.25 D,	**L –3.50 D**	**→**	**$6/6^{+2}$**	**"same"**

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5. What are the differences between a +1 Test and a Blur Function refraction?

+1 Test	Blur Function Refraction

NOTES