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Clinical protocol and the role of the eye-care practitioner

Dr Peter Allen, Prof Bruce Evans, Prof Arnold Wilkins

This series of articles has described various aspects of visual characteristics of reading difficulties and the background behind techniques such as the use of coloured filters in helping to reduce the difficulties that are experienced. The present article, which is the last of this series, aims to describe a clinical protocol that can be used by the busy eye care practitioner for the investigation and management of such patients. It also describes the testing techniques that can be used for the various assessments.

Warning: DO NOT LOOK AT FIGURE 7 IF YOU HAVE MIGRAINE OR EPILEPSY.

The busy eye-care practitioner often finds that decisions on patient management must be made quickly and effectively. This can be especially challenging when patients present with less commonly encountered visual difficulties. This article uses the information described previously in this series to produce a clinical protocol that can allow the practitioner to determine the best course of action for their patients with reading difficulties. The protocol is summarised in Figure 1.[1]

Eye-care practitioners, particularly community optometrists, will have a typical 'routine sight test/eye examination procedure' that they use for patients. It is clear from this series of articles that they will need to use a more extensive protocol for people with Specific Learning Difficulties (SpLD), and those who might benefit from precision tinted lenses. This is sometimes called a 'special investigation' and it starts with a detailed investigation of the presenting symptoms, as outlined in Part 1 of this series of articles.

The Eye Examination

The present series of articles has discussed several visual problems that can be associated with reading difficulties. The various conditions can cause symptoms that are similar to one another, so the eye-care practitioner is faced with a challenge of differential diagnosis. It is recommended that before visual stress is diagnosed, other optometric factors should be excluded with an extensive eye examination. The eye examination would typically include the components listed in Table 1.

Most of the tests in Table 1 will be familiar to optometrists, but a few of the less common ones will be described later. Diagnostic criteria and the decision as to when to treat are discussed in Parts 2-4 of this series of articles.

What refractive correction should be worn during ocular motor tests

During binocular vision and accommodative (ocular motor) tests a question that sometimes arises is "what refractive correction, if any, should the

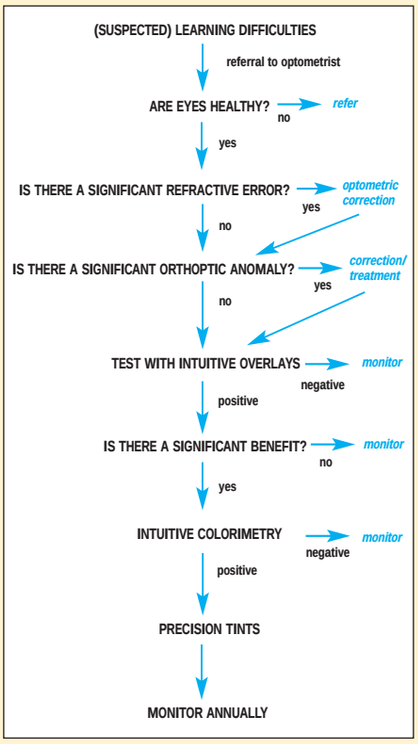

Figure 1
A clinical protocol for the management of patients with reading difficulties

General Description	Details
Refractive error & visual acuity	Presenting vision at distance & near; Retinoscopy; Subjective refraction; Corrected visual acuity
Health assessment	Pupil reactions; Ophthalmoscopy; Visual fields (if old enough); Colour vision (Ishihara Plates)
Ocular motor assessment	Cover-uncover test at distance and near; Dissociation test at distance & near (e.g., alternating cover test, Maddox rod, Maddox wing); Aligning prism at distance & near (Mallett fixation disparity test); Ocular motility; Near point of convergence; Stereoacuity; Amplitude of accommodation; Accommodative lag (MEM retinoscopy); Facility of accommodation; Fusional reserves at near (possibly distance); AC/A ratio
Coloured filter screening	Intuitive overlays; Rate of reading test; Pattern glare test
Coloured filter prescribing	Intuitive colorimeter; Precision tinted lenses

Table 1
Components of the eye examination for people with specific learning difficulties (SpLD). Not all tests may be appropriate in every case

patient wear?" Most commonly, the purpose of these tests is to determine the significance of any visual problems that the patient may have with near work. So, if glasses are worn for near work at the appropriate distance more than 50% of the time, then the patient should wear their glasses during ocular motor tests at the same distance. An exception is ocular motility, when spectacles are not usually worn unless there is a very high refractive error, in which case the test should be done with and without glasses.

It is also useful to repeat some binocular vision tests when a practitioner proposes to make a significant change to the refractive correction (e.g. prescribing glasses for the first time), to check that the new refractive correction is not going to worsen the situation. This can also be sensible if there is a significant chance that the patient may 'change' the refractive correction, by stopping wearing their glasses. For example, if a hypermetropic child rapidly breaks down to an esotropia without their glasses, then parents should be warned to have a spare pair of spectacles and to avoid periods where the child would be without them.

Binocular stability assessment and fusional reserves

Binocular instability is characterised by low fusional reserves and vergence instability and can cause symptoms including diplopia, blur, visual perceptual distortions and headaches. The best clinical method for investigating binocular stability is to use the "OXO" test on the near Mallett unit (Figure 2). During this test, the eyes are fused in a manner similar to that when the patient is reading. In addition to the normal questions regarding the alignment of the Nonius (green) lines whilst the patient fixates the X, a supplementary question of "do one or both lines ever move?" should be asked.[2] Any movement of the Nonius marker(s) should then be eliminated with either prisms or spheres (base-in or negative sphere for an exo-slip), starting with 0.5Δ and progressing in 0.5Δ steps until the movement disappears.[3]

Fusional reserves should be assessed at near using a prism bar or phoropter. Results can differ according to the procedure used, so it is important to note which method was used when recording the results. A prism bar is probably the best method because the patient's eyes can be watched. Base-out prism is used to measure the convergent fusional reserve and base-in prism is used to measure the divergent fusional reserve. The fusional reserve that opposes the heterophoria should be measured first (i.e. convergent reserve for exophoria). The blur, break and recovery points for both are required. The patient is asked to fixate a detailed target whilst the optometrist increases the prism before one eye. The prism power is gradually increased until the target first becomes blurred (blur point), then first becomes double or moves to the side (break point), and then, as the prism power is reduced, when the target becomes single again (recovery point); the prism value at each of these points should be recorded.

If the amplitude of the fusional reserve (from divergent to convergent break points) is less than 20Δ then the patient may have binocular instability.[3] If the fusional reserve is less than twice the heterophoria it opposes, then the patient may have decompensated heterophoria (Sheard's criterion). Binocular instability can be treated with fusional reserve exercises, or with spheres or prisms if associated with decompensated heterophoria. Decompensated heterophoria can be treated or corrected with eye exercises, prisms, or spheres.

Accommodative lag

Measurement of the amplitude of accommodation is perhaps the most routine assessment of accommodative function. An additional test of accommodative function, monocular estimation method (MEM) retinoscopy, is particularly useful in pre-presbyopes with SpLD because it provides an objective assessment of accommodative accuracy (i.e. the presence of any lag or lead of accommodation). The patient binocularly fixates a detailed target on the retinoscope and is asked to keep this in clear focus. Retinoscopy is carried out along the horizontal meridian and lenses are very briefly held in front of each eye to neutralise the retinoscope reflex. Each lens should only be presented monocularly and for a split second so as not to disrupt the status of the patient's accommodative and binocular response. The accommodative lag is usually about +0.50D (although this is dependant on refractive error stability);[4] values of greater than +1.00D lag may represent accommodative insufficiency.[3] If a

Figure 2
Mallett near vision fixation disparity test, which is used to determine the aligning prism (associated heterophoria) or aligning sphere

negative lens is required to neutralise the reflex this suggests that the patient may be over-accommodating (lead).

The test may give useful additional information if the amplitude of accommodation is low, and in those patients that are uncooperative. A slightly different approach to this technique (Nott retinoscopy) involves the fixation target being held in a constant position and the retinoscope being moved to and fro to obtain reversal. Typically, this reveals a slightly lower degree of accommodative lag.[5]

Accommodative facility

The ability to alter accommodation rapidly and accurately is called accommodative facility and can be assessed using the ±2.00DS accommodative flipper test (Figure 3). The flipper consists of a pair of +2.00DS lenses mounted on one side of a flipper bar and a pair of -2.00DS lenses mounted on the opposite side. The patient fixates a near target (at 40cm) while the optometrist alters the accommodative stimulus by placing either the plus lens pair (stimulus of 0.50D) or the negative lens pair (stimulus of 4.50D) in front of the patient's eyes. The test should always begin with the +2.00DS lenses over the patient's up-to-date refractive correction. The patient reports when the near target is seen clearly after each alteration in accommodative stimulus, whilst the optometrist counts the number of times clarity is obtained in one minute. This number divided by two gives the accommodative facility rate in cycles per minute.

A suppression check should be included for any binocular measurements. The "OXO" letters and Nonius lines on a near Mallett unit can be used in conjunction with the polarising filters for binocular accommodative facility testing. The vertical OXO target is recommended because the patient is less likely to be distracted by movement of the Nonius markers than if the horizontal OXO test is used.

Normative values for children and young adults are sometimes given as 11 cycles per minute (cpm) for monocular facility and 8 cpm for binocular facility. But these figures are the mean value reported in a normative study by Zellers and colleagues[6] as opposed to the 95% confidence interval, which is the mean ±2 standard deviations (SDs). Data from Zellers et al.[6] indicated a very wide SD range, which may be because the test is confounded by many variables other than accommodative facility, such as verbal response, attention, and interpretation of blur. A recent study of student volunteers however demonstrated that objective measures of accommodative function were highly correlated with the subjective responses of persons undergoing the accommodative facility test.[7] Patients with low accommodative facility rates may benefit from an accommodative facility training regime in order to improve their dynamic accommodation function.[8]

Coloured filters

If symptoms or reading difficulties still persist after the detection and treatment of any refractive and/or ocular motor problems, then optometrists should investigate the effect of coloured filters. It is best, whenever possible, to test the patients in lighting conditions similar to those used when patients experience their symptoms. Note that lighting conditions in school are far brighter than the recommended level of 300-500 lux (often in excess of 1000 lux). The lighting is usually fluorescent and 80% of schools continue to be lit with low frequency fluorescent lighting that emits 100Hz flicker.[9]

Testing usually starts by screening with coloured overlays. Sometimes, a teacher will have carried this out already, but commonly the eye-care practitioner will be the first person to carry this out. The Intuitive Overlays are a range of coloured overlays that have been designed to sample colours systematically,[10] are of an adequate size to be effective,[11] and have a sufficient range of colours.[12] The Intuitive Overlay consists of twenty A5 sized overlays (two sets of ten different coloured overlays). One surface of the overlay has a matt finish whereas the other side is gloss. A Test Page incorporating two passages of text (visible in Figure 4) should be used.

Procedure for Intuitive Overlay assessment

The procedure for Intuitive Overlay assessment is given in Table 2.

It is always worth confirming the consistency of choice of the overlay or overlay combination. If the patient consistently chooses a particular overlay or combination of overlays then it is possible to measure the effects of the overlays on reading speed (see later) – this can be a helpful indicator of whether or not the overlay is likely to be used.

A computerised version of the Intuitive Overlay test is also available, and this includes the Wilkins Rate of Reading Test (see later) and a method of individually printing coloured overlays.

Figure 3
Accommodative facility testing using binocular flippers

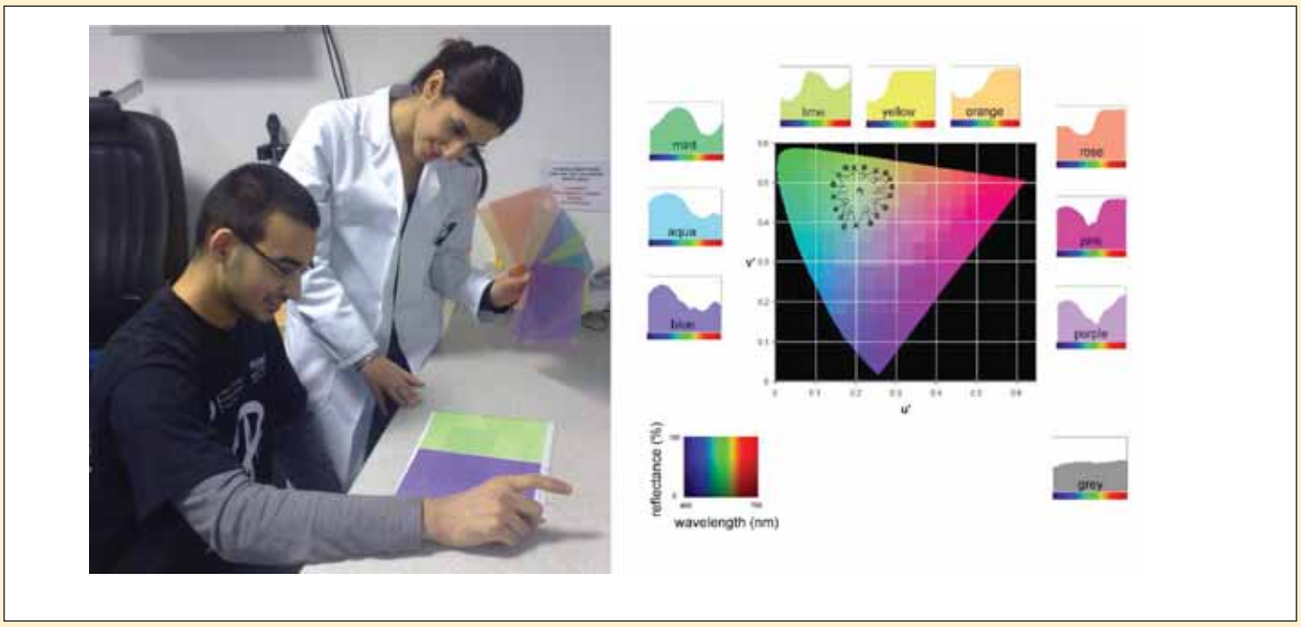

Figure 4
Intuitive Overlays. The left side of the figure shows the overlay test underway. The right side of the figure shows the spectral reflectance of the overlays; these surround the Uniform Chromaticity Scale diagram of the International Lighting Commission (CIE 1976). The inner ring of white points, and the central point (grey overlay) show the chromaticities of the nine Intuitive Overlays, when in contact with a white (spectrally uniform) page. The chromaticities of double overlays formed by placing one overlay on top of another are shown by the outer ring of points. The filled points are the chromaticites of two overlays of identical colour. The crosses mark the chromaticities of two overlays of neighbouring colours. The lines connect the chromaticities of the double overlays with those of constituent single overlays. Note that the reflectance functions take no account of the level of the illumination.

Whether this provides a colour suitable for overlays however has not yet been evaluated.

Intuitive Overlays are a rapid and easy method of screening for the benefit of colour on reading performance, but they have some drawbacks. Only a limited range of colours can be tested and prescribed, and the overlays can only be used for reading and are not suitable for writing, white boards, or computer use. If a person benefits from a coloured overlay then they are likely to be helped more by precision tinted lenses since these can be prescribed individually, with greater precision; they can also help with writing, computer use, and whiteboards as well as reading. As described in Part 3 of this series of articles, precision tinted lenses are typically prescribed on the basis of testing with the Intuitive Colorimeter.[13]

Children are generally only tested with the Intuitive Colorimeter if they have shown a significant benefit from a coloured overlay. There are two ways of determining this. The first approach ('sustained use') is to dispense the child with an overlay to use for a few weeks and to invite them to return for testing with the Colorimeter if the child, parent, and/or teacher feel that the overlay is helping. An alternative approach is to test the immediate effect of the coloured overlay on the child's performance. The most common method of doing this is to use the Wilkins Rate of Reading Test (WRRT), which is described later. Practitioners need to be flexible and be prepared to use either of these methods, or both, when determining whether to progress to testing with the Colorimeter. For some children, the main benefit from the overlay is in reading performance, so the WRRT will be the best approach; for others, the main benefit from the overlay is in visual comfort, so the sustained use approach will work best.

The Wilkins Rate of Reading Test (WRRT)

The WRRT[14] consists of ten simple words arranged in a random order and in a small closely spaced font (Figure 6). There are four passages (labelled A to D) of random words included in the test pack.

First, the patient is asked to read passage D to familiarise themselves with the test. They can be stopped after 30 seconds, or earlier, if this is effortful. Their preferred overlay should then be placed over passage A and the patients asked to read the words aloud as fast as possible, for one minute, while trying not to make mistakes. Time them with a stopwatch, or an interval timer. The record sheet should be used to score their reading; place a stroke through omitted words and ignore words read aloud that are not in the text. If a line is missed out then place the whole line in brackets (more discrete than crossing it through). Use a double stroke (//) to indicate the final word spoken by the patient. Note the total number of words correctly read, subtracting omitted words and lines. If a pair of words has been reversed in

Initial Set-up	Position the Test Page on the table in front of the person being tested at a comfortable reading distance (about 40cm from the eyes). Place the Grey overlay on the page with the gloss side up and check that, from where the patient is sitting, no light sources (room lights or windows) are reflected from the surface of the overlay. If they are, then reposition the test materials.
Familiarisation with the test text	Will the patient be able to read all the words on the Test Page? If in doubt, ask them to read the top line aloud. If the patient cannot read the words, go straight to the questions on the Record Sheet and miss the next step. If the text can be read, ask the patient to read the passage out loud for one minute. (Reading tires the eyes so that the symptoms are more likely.) • Explain that the reading is for practice. • Explain that it will not make sense and will therefore sound strange. • Stop them after about 1 minute. While the patient is still looking at the text, read the questions listed on the Record Sheet: • "Do the letters stay still or do they move?" • "Are they clear or are they blurred (fuzzy, difficult to see)" • "Does it hurt your eyes to look at the page or it is OK?" Note the answers in the first column beside the questions. The greater the number of reported symptoms, the greater the chance that an overlay will be useful.
Finding the best overlay	Put the overlays in a pile in the following order from top to bottom: 1. Rose 2. Lime-green 3. Blue 4. Pink 5. Yellow 6. Aqua 7. Purple 8. Orange 9. Mint-green The above colours are those used in the Intuitive Overlays, omitting Grey since that seldom helps; other packs have slightly different colours. The above sequence can be approximated with other packs. There is nothing magic about the sequence. Its purpose is simply to reduce the chances of similar or opposite (complementary) colours being placed next to each other.) Take the top overlay and place it over the left-hand side of the Test Page, matt side uppermost. Ask the person which side (left or right) is clearest and most comfortable to see. If the white side is clearest: • Remove the overlay and replace it with the next one from the pile. If the coloured side is clearest: • Turn the overlay over and check whether it is better with the matt side or gloss side uppermost. Use the preferred side uppermost with the remaining overlays. • Leave the overlay in place with the best side uppermost. Take the next overlay from the pile. Place it on the other side of the test page so that both sides are now covered by coloured overlays. Continue with the remaining overlays in the pile. Each time, leave the best colour in place and replace the poorer colour with the next overlay in the pile. Stop when you get to the bottom of the pile. If the patient cannot make up their mind, make a note of both colours. Change one of the colours and continue. Re-introduce the other colour at the end of the pile. If the white page is preferred to all the overlays, stop testing. Check that the final choice of overlay is better than no overlay. If it is, note the final choice of overlay (best single overlay) on the Record Sheet. When you have selected the best overlay, cover one of the passages of text on the test page with the overlay and cover the other passage with white paper. Ask the person to look at the text covered by the chosen overlay. Ask the questions on the Record Sheet again. Note the answers in the second column. The greater the reduction in symptoms the more likely the overlay is to be used. Does the best single overlay colour reduce the distortions, but not get rid of them completely? If so, try stronger colours from double overlays as described next.
Are stronger colours better?	Stronger (more saturated) colours of similar hue can be obtained using two overlays placed one on top of another to create double overlays. Only the combinations shown in the outer ring of the figure below are needed to sample colours systematically. Arrange the best single overlay in landscape orientation so that it covers both passages of text on the test page. Now make up one of the three double overlays by placing an additional overlay over one side of the test page. For example, if the best single overlay is Rose, you should place a Rose overlay over both sides of the text. You should then take an additional Rose overlay and place it over one side only. You should then ask which side was best. Leave the best side as it is and on the other side, show another of the double overlays. If the double Rose overlay was on the better side, simply place a Pink overlay over the other side. If the single Rose overlay was on the best side, remove the additional rose overlay from the other side and replace it with the Pink overlay. Repeat this process with the additional Orange overlay. Each of the three double overlays should be trialled in turn. If the stronger colours are better, then find the best of the three. Finally, position the double overlay over one of the passages of text and cover the other passage with white paper. Ask the questions on the Record Sheet a third time, and note the answers in the third column.

Table 2
The Intuitive Overlay assessment procedure

order, count only one of the pair.

This procedure is repeated with the coloured overlay removed and using Passage B and again, without the overlay, with Passage C. The procedure is then repeated, now with the overlay, using Passage D. The practitioner should then calculate the average percentage increase in reading speed with the overlay.

If a percentage increase in reading speed of 5% or more is shown, then the patient may benefit from testing with the Intuitive Colorimeter, particularly if they reported symptoms. If a percentage increase in reading speed of 10% or more is shown with the overlay, then they are very likely to benefit from precision tinted lenses and should definitely be tested with the Intuitive Colorimeter.

The Pattern Glare Test

Another test that can provide useful information that can help to predict reading performance, particularly in patients where the main problem seems to be headaches or discomfort, is the Pattern Glare Test (Figure 7). The fourth article of this series discussed the mechanism for the benefit from coloured lenses and noted that the most likely explanation relates to a hyperexcitability of the visual cortex. The hyperexcitability is likely to result in sensitivity to certain visual patterns.[15] Pattern glare can be detected with the Pattern Glare Test.[16] With this very simple test, the patient describes their symptoms (in answer to a list of questions) whilst viewing each of three visual patterns, and their responses indicate their susceptibility to pattern glare. The test can be useful for determining the cases most likely to benefit from coloured filters.[17]

The Pattern Glare Test comprises three gratings of differing spatial frequencies: low SF (Pattern 1), medium SF (Pattern 2), and high SF (Pattern 3). A normative study of the Pattern Glare Test showed that people have an abnormal degree of pattern glare if they achieve a score of >3 on the medium SF grating or a score of >1 when the score for the high SF pattern is subtracted from the score for the medium SF pattern [27]. Such people are likely to benefit from coloured filters [26].

The Intuitive Colorimeter

Intuitive Overlays are a useful screening tool but are not particularly good as a long-term solution for reading difficulties, due to a limited range of colours and the inconvenience of having to be removed and replaced every time a page is turned. Patients are almost always helped more by the use of Precision Tinted lenses, since they are present in front of the eyes and can therefore be used for board work, writing, and computer work.

The Intuitive Colorimeter, described in the third article in this series, is an instrument that illuminates a page of text with coloured light and it can be used to prescribe individually specific tinted lenses (Figure 8). It enables separate variation in hue (colour) and saturation (depth of colour) without an associated change in luminance (brightness). The hue, saturation and luminance can all be adjusted independently. One major advantage of the Intuitive Colorimeter over the Intuitive Overlays is that the variation in colour is continuous rather than in discrete steps. The entire visual field is stimulated with coloured light, as when tinted spectacles are worn. The test procedure is described in Table 3.

Prescribing advice for precision tinted lenses

Children should be advised to wear their precision tinted lenses for schoolwork, including homework, if they find them helpful. For adults, they are likely to be helpful for office work and reading. Often users find them valuable for computer use, sometimes for television, and for environments where there are high levels of fluorescent lighting, such as supermarkets. But patients should be advised not to wear them outdoors as sunglasses since they are not likely to protect the eyes from sunlight in the way that sunglasses will. Precision tinted lenses should usually not be worn when driving or riding a bicycle, if they are likely to impair the perception of traffic signals. The computer program that is provided with the colorimeter allows practitioners to check this, as well as the safety for use in daylight, for the rare cases where a patient may wish to wear the lenses constantly (e.g. migraine sufferer). The wearing of any tints for driving at night is prohibited.

Figure 5
Intuitive Overlay colours. Each single overlay (inner ring) is associated with stronger colours (outer ring) formed by combining the overlay with another of the same or similar colour

Funding and finding an appropriate practitioner

The most accepted mainstream intervention for children with SpLD is specialist teaching, ideally on a one-to-one basis. This is justified since the main cause of the commonest SpLD, dyslexia, is poor phonological decoding (see Part 1 of this series). But many children with reading difficulties or other SpLD will also have visual problems. In some cases, children may be misdiagnosed as having SpLDs when in fact all they need is an optometric intervention.

The most common visual problem in people with reading difficulties seems to be visual stress, but before this can be diagnosed practitioners need to rule out a variety of other visual disorders (Figure 1). This requires a detailed eye examination, which, including the testing for coloured filters, typically takes about an hour. For community optometrists, the NHS sight test fee will not cover this detailed investigation whilst there are very few secondary care NHS hospitals that currently fund

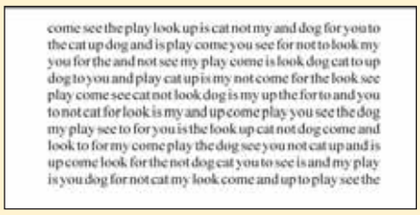
come see the play look up is cat not my and dog for you to
the cat up dog and is play come you see for not to look my
you for the and not see my play come is look dog cat to up
dog to you and play cat up is my not come for the look see
play come see cat not look dog is my up the for to and you
to not cat for look is my and up come play you see the dog
my play see to for you is the look up cat not dog come and
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Figure 6
The Wilkins Rate of Reading Test

precision tinted lens testing. It is unfortunate that the vast majority of people that need this testing, and Precision Tinted lenses, currently have to fund this themselves, and many of the patients who are in most need simply cannot afford to pay.

Not all eyecare practitioners will have the expertise and equipment to carry out the detailed investigations of children with SpLD. But within the professions of optometry, orthoptics, and (to a lesser extent) ophthalmology, there are practitioners who have specialised in assessing and treating visual factors that can affect reading and learning. Parents, teachers, and educational psychologists often ask how they can find such a specialist practitioner in their area and in response to this question an organisation was established in 2007 called the Society for Coloured Lens Prescribers.

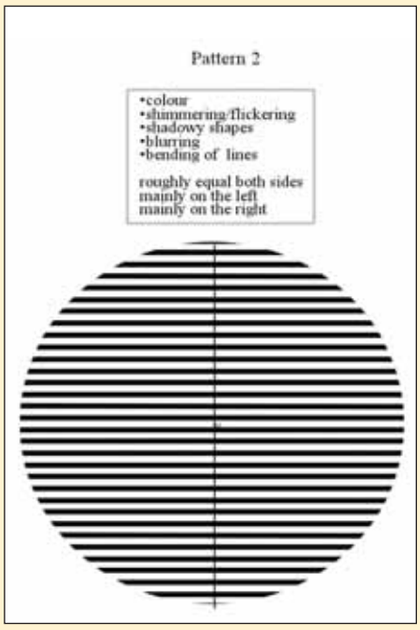

Figure 7
The Pattern Glare Test. The test comprises three patterns, instructions, and a simple scoring system. Only one of the patterns is shown here

Society for Coloured Lens Prescribers

The Society for Coloured Lens Prescribers is an Internet based organisation (www.s4clp.org). It is a voluntary body that aims to ensure that the public receives a high level of care from practitioners specialising in this field. Members of the multidisciplinary Society have consented to abide by a code of conduct, which ensures that they have appropriate training (CPD), experience, and equipment.

A list of members of the Society is published at www.s4clp.org for the general public and educational professionals to view, so that they can find practitioners who can provide expert advice on coloured filters and prescribe these when appropriate. The list is divided into regions of the country to make it easier to find a practitioner and also lists a few international members.

The code of conduct states that members will adopt an evidence-based approach and will only prescribe coloured lenses after a full eye examination to detect other relevant conditions. The society is multi-disciplinary, with membership open to optometrists, orthoptists, opticians, ophthalmologists, psychologists, and teachers. Practitioners can join through individual membership, where the practitioner (typically an optometrist) provides for all the visual needs of people who might need coloured filters (e.g., assesses ocular health, binocular co-ordination, refractive error; and uses coloured overlays and the Intuitive Colorimeter). Practitioners can also join the society as part of a team who together provide for the visual needs of people who might need coloured filters. For example, in a team there may be an ophthalmologist assessing ocular health and refractive error, an orthoptist assessing binocular co-ordination and testing with coloured overlays, and a dispensing optician using the Intuitive Colorimeter and dispensing precision tinted lenses.

The list of practitioners specialising in this field on the Society's website is not only useful to parents and teachers, but also to community optometrists who have not specialised in this field. The list will help them to find a colleague to whom these cases can be referred. The Society also maintains a list of courses that offer training in this subject for eyecare practitioners. There is no charge for membership of the Society and an application form can be found on the website (www.s4clp.org).

Conclusion

It is hoped that this series of articles will encourage eyecare practitioners to specialise in caring for people with reading difficulties and specific learning difficulties. It is a challenging but fascinating area and there is growing awareness amongst teachers and parents of the need for specialist eyecare for people with these problems.

With over 10,000 optometrists in the UK, most of whom work as community optometrists, it is recognised that not all optometrists will be likely to have specialist knowledge in this field. But it is hoped that the information in these articles will be useful as background reading for 'general practitioner community optometrists' in helping them to detect patients who would benefit from referral to a colleague who has specialised in this subject. Most of these patients could be identified during a routine eye examination if the practitioner simply asks 'Do letters or words ever blur, jump, or move?' and 'Is s/he having any difficulties with progress at school?' The cases that report problems in these areas would be likely to benefit from investigation that follows the clinical protocol outlined in this article or by referral to an eyecare practitioner who has specialised in this field.

Declaration of interest

Peter Allen has no proprietary interest in any of the products mentioned in this article. The Intuitive Overlays, Wilkins Rate of Reading Test, Intuitive Colorimeter and Precision Tinted Lenses were invented by Arnold Wilkins who receives an award to inventors from MRC, based on a proportion of the royalty for these

Figure 8
Coloured trial uses used in conjunction with an Intuitive Colorimeter

products. The Pattern Glare Test was developed by Arnold Wilkins and Bruce Evans, who receive royalties based on the sales of this product.

About the authors

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References

See www.optometry.co.uk/references

- Lift the cover from the viewing window and place the test plate of text on the inner viewing surface.
- Ensure all the controls are at zero and both luminance attenuators are off.
- Turn the room lights off.
- The patient views the test plate and reports any perceptual distortions – use the patient's terminology when referring to the distortions, subsequently.
- The patient then compares the text as you change the colour by gradually increasing the saturation, leaving it at the mid level for 5 seconds, and then reducing it again.
- Note the patient's response on the Colorimeter record card
  - → +2 = perception improves a lot with colour
  - → +1 = perception improves a little with colour
  - → 0 = no appreciable change in perception with colour
  - → -1 = perception worsens a little with colour
  - → -2 = perception worsens a lot with colour
- Move the hue to 30 degrees and repeat the above step
- Repeat in steps of 30 degrees until the fan chart on the record card is complete (12 different colours)
- There may be occasions when a particular hue causes perception to worsen (-1 or -2 responses). If this occurs then it is important not to allow the patient subsequently to come within 20 degrees of this hue(s).
- For each colour that demonstrated an improvement in perception the patient is required to adjust the saturation in order to achieve the optimal effect.
- Present each of these optimally saturated colours in turn to find which one results in the most improvement in perception. This is achieved by a process of elimination, by comparing one setting to another, presenting each in turn.
- The patient is then shown hues 20 degrees above and below their chosen hue (the saturation is kept constant at the optimal value). The step size can be decreased to 10 degrees if a clear difference is seen. Occasionally, it might be necessary to change in larger step sizes if the patient is vague or non-specific.
- The patient is then asked to adjust the saturation, with the hue kept constant, in order to ascertain the minimum saturation needed to achieve the maximum comfort and/or clarity.
- The attenuator is then used to reduce the luminance of the display. The purpose of the attenuator is (1) to check for residual glare (2) to check whether dark lenses will be tolerated (necessary for certain strongly saturated colours).
- If an attenuation of 50% is preferred over no attenuation then it is possible that a slightly increased saturation will reduce glare and will give a preferable tolerance to brightness.
- The values of hue and saturation obtained are entered into a computer program, which calculates the transmission of the lenses that will supply the chosen shade of colour. The program will also indicate the luminance setting necessary to provide a luminance similar to that when lenses are worn under normal office lighting conditions. If the patient is tolerant of a range of luminance levels the lenses should be ordered with the maximum transmission possible. If the patient requires a saturated colour, sometimes this colour can only be provided in lenses that are dark. If the patient is intolerant of a dark attentuator setting, then it will be necessary to establish a compromise between saturation and transmission when the trial lenses are offered.
- A combination of the coloured trial lenses that match the final Colorimeter setting is identified using the computer program. The program estimates the combination of trial lenses necessary to provide this close match, and the program is available from: www.essex.ac.uk/psychology/overlays/lens.htm
- Place the indicated trial lenses together and check that they match the Colorimeter setting using the standard white comparison port and the colour comparison port.
- Make another combination of lenses for the other eye. Fit the lenses into the lens holder and view the text in the Colorimeter, which should now be illuminated with bright white light.
- Ask the patient if the appearance is as good as it was previously. If not then the lenses should be adjusted. Just occasionally patients may prefer lenses that are more strongly saturated than the maximum saturation available in the Colorimeter.
- The patient should compare the lenses under different lighting conditions but particular attention should be given to the lighting conditions under which they normally read.
- An ultraviolet filter should be added to each lens stack, unless the program indicates that this is unnecessary (because the coloured dyes already remove short wavelength light). If the addition of the ultraviolet filters does not have a detrimental perceptual effect then leave them in the holder.
- In patients who report perceiving colours differently in the two eyes, and in patients with known or suspected monoocular pathology, it may be worthwhile adjusting the tint differently in the two eyes, by changing hue angle with the help of the program.
- Prescribe in frames that are large enough to cover the entire field of view

Table 3
Assessment procedure for the Intuitive Colorimeter

Module questions

Course code: c-11112

Please note, there is only one correct answer. Enter online or by the form provided

An answer return form is included in this issue. It should be completed and returned to CET initiatives (c-11112) *OT*, Ten Alps plc, 9 Savoy Street, London WC2E 7HR by July 22 2009

1) Which statement is MOST accurate about the clinical protocol for managing children with reading difficulties?
a. If overlays help, Precision Tinted lenses are needed but binocular vision does not have to be assessed
b. The Intuitive Colorimeter should be used before screening with overlays
c. Ocular health does not need to be assessed
d. Once Precision Tinted lenses are prescribed, the colour should be checked annually

2) Which statement is MOST accurate about eye examinations required for children with reading difficulties?
a. They can only be carried out by a community optometrist
b. They can only be carried out in the hospital eye service
c. They are likely to include tests over and above the usual NHS sight test
d. They are likely to include tests that are unfamiliar to optometrists and orthoptists

3) Which statement about fusional reserves is FALSE?
a. The fusional reserve opposing the heterophoria should be measured first
b. Base-in prism is used to measure the convergent fusional reserve
c. The blur, break and recovery points should be noted
d. Fusional reserve exercises can be used to treat binocular instability

4) Which statement about lag of accommodation is FALSE?
a. It is usually +0.50D in magnitude
b. A value of less than +1.00D may represent accommodative insufficiency
c. A value of more than +1.00D may represent accommodative insufficiency
d. It can be measured using MEM Retinoscopy

5) Which statement about the Pattern Glare Test is TRUE?
a. It comprises four gratings of differing spatial frequencies
b. A score of under 3 on the medium SF grating indicates abnormal pattern glare
c. Reading speed is measured during the Pattern Glare Test
d. It can be useful for determining patients most likely to benefit from coloured lenses

6) Which of the following is NOT useful for deciding who needs testing with the Intuitive Colorimeter?
a. The Pattern Glare Test
b. Issuing a coloured overlay to see if a person uses it for a sustained period
c. Investigating the effect of the coloured overlay on the rate of reading test
d. The 100 hue test

7) Which statement about coloured filters is MOST accurate?
a. Coloured filters are the best long term solution for reading problems
b. Precision tinted lenses help the patient less than coloured overlays
c. A major advantage of the Colorimeter is that the variation in colour is continuous rather than in discrete steps.
d. The Colorimeter allows variation in hue and luminance.

8) Which statement about the attenuator on the Intuitive Colorimeter is FALSE?
a. It is used to check for residual glare
b. It is used to check whether the saturation is sufficient
c. It is used to check whether a dark tint will be tolerated
d. It is used to check whether the addition of a grey dye is necessary

9) Which statement about the tinted trial lenses of the Intuitive Colorimeter is TRUE?
a. The tint can be checked under usual lighting conditions encountered
b. A compromise between the saturation of tint desired and the darkness of tint necessary is established
c. They allow examination of the effects of a different tint in each eye, where indicated
d. All of the above

10) Which statement about Precision Tinted lenses is TRUE?
a. The tint can be checked under usual lighting conditions encountered
b. The lens colour will be the same as the overlay colour
c. The lens colour will not need to be changed
d. Normal colour vision is required for testing with Precision Tinted lenses

11) Which statement about wearing Precision Tinted lenses is TRUE?
a. They should only be worn under fluorescent lighting
b. They are usually worn indoors
c. They are usually worn outdoors
d. They will not interfere with colour perception

12) Which statement about the Society of Coloured Lens Prescribers is FALSE?
a. It is based in Slough
b. It is an Internet based organisation
c. It has members from a variety of disciplines
d. It encourages specialist practitioners to provide high levels of care

Please complete online by midnight on July 22 2009 - You will be unable to submit exams after this date – answers to the module will be published on www.optometry.co.uk