

TINTED LENSES AND DYSLEXIA: A REVIEW OF THE LITERATURE

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Abstract

Recent neuroscientific evidence has suggested that dyslexia may be the result of micro architectural changes in the language areas of the brain. However, treatments for dyslexia aimed at helping or curing one or more signs of dyslexia are still widespread despite a lack of any empirical or statistical evidence to support the validity of the treatment.

Amongst the therapies which have emerged for dyslexia is the use of tinted lenses.

Since 1983 when the use of tinted lenses to treat dyslexia was suggested much interest has been generated into the effects of this technique. Since then the treatment has been used to treat dyslexic patients in Australia despite the lack of supporting clinical evidence.

The review of the literature on tinted lenses revealed that there is no consensus of opinion on the efficacy of this treatment. The main questions that remain unanswered in relation to the treatment are firstly; does it work and secondly; if so does it affect vision or is it a placebo effect?

Key words: Tinted lenses, dyslexia, contrast sensitivity, children, reading.

INTRODUCTION

Dyslexia, a severe reading problem that cannot be accounted for in terms of low intelligence, has been reported to occur in between 4 and 10% of school children. Many of these children have other problems such as poor spelling, clumsiness, poor motor control, difficulty distinguishing between shapes and difficulties differentiating between right and left. They also have lower verbal than practical intellectual skills.¹

Many studies on dyslexia have pointed to abnormalities in the visual system, including visual acuity problems,^{2,3} ocular motor control anomalies and defective binocular vision. Despite this no definite causal relationship between the visual system in dyslexia has emerged.

Recent evidence of cortical abnormalities coupled with the mounting evidence of linguistic

anomalies suggest that dyslexia is more likely to be a problem of language secondary to micro architectural changes in the brain.⁴⁻⁷

As dyslexia manifests itself in tasks other than reading it appears that activities supported by the affected parts of the brain are also affected.

Following a "60 Minutes" television programme broadcast in Australia in which Irlen, a psychologist from USA, advocated the use of tinted lenses in patients with learning difficulties much interest was generated into the effects of this technique. The report on television suggested that tinted lenses improved reading abilities instantaneously. During the lectures given in Australia and one given in the USA claims advocating improvement after one month were made.^{8,9} These conclusions were based on observation and self report from 37

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learning disabled adult students. Unfortunately no control group was tested and motivation and/or placebo effects were not taken into account. Also no data or statistics to back the claims of reading improvement have been forthcoming.

These subjects complained of symptoms such as words going out of focus while reading, words moving about on the page, words appearing washed out on the white paper, disturbances and distortions of perceptual lines, photophobia, unstable appearance of the print, reduced span of recognition, reduced field of vision and complaints that the page was too bright and the page competed with the print for the subject's attention. These symptoms have been described in many publications discussing the symptoms associated with dyslexia.¹⁰⁻¹⁴

Irlen suggested that the symptoms were due to a retinal defect causing sensitivity loss to a particular part of the retina. She called the condition "scotopic sensitivity syndrome". The name "scotopic sensitivity syndrome" implies that it is sensitivity to very dim light conditions (when the rod system is activated) which causes the problems experienced by dyslexics, however, the problems are generally reported to occur under normal reading conditions (i.e. when using cone receptors in photopic conditions). No other reports that the sensitivity of the scotopic system in any way affects reading ability in dyslexics or normals were found in a medline search.

Irlen claimed that tinted lenses improved reading in patients with scotopic sensitivity because the tinted lenses excluded a wavelength of light that had interfered with reading ability. The optimal tint was selected by a procedure to determine the appropriate strength and density of tint needed. Details of this procedure have not been published to date.

Over the years there have been a number of studies on the effect of using coloured letters and/or paper on reading. Tinker and Paterson¹⁵ compared reading speeds for 10 combinations of coloured ink on coloured paper as well as black ink on white paper. They found that reading was faster for black print on white paper than for any other combinations. As a result they suggested

that luminance contrast was more important in determining reading speed than was colour.

Another study by Luckiesh and Moss¹⁶ also showed that reading was fastest with black print on a white background. They measured reading rates for black letters on 10 different coloured papers ranging from white to red. They suggested that the different coloured backgrounds affected the contrast and that although subjects read faster at higher contrasts (black letters on a white background) there was only a 7% difference in mean reading rates across the whole range of colours.

In 1980 Meares¹¹ attributed reading difficulties experienced by some dyslexics to the difficulty in seeing the words due to the high contrast between the words and the background. She suggested the use of dirty perspex sheets over the reading material of dyslexic subjects improved their reading and that the improvement may be secondary to a reduction in the brightness of the printed material.

Rozin et al¹⁷ taught dyslexics and normals to read using black ink Chinese figures as well as English words on white paper. They demonstrated that the dyslexics did not have any 'visual' problems when learning to read the Chinese figures. They performed as well as the normal subjects. The dyslexics 'visual' problems emerged when the tasks involved alphabetic sequencing. They concluded that it would be impossible for the dyslexics to learn to read Chinese figures if their problem was one of vision or visual integration. Furthermore the finding that many dyslexics show prowess at technical drawing and become architects and draftsmen casts more doubt on the theory that high contrast affects the ability to resolve fine detailed print.¹⁸

A number of researchers in Australia have assessed the effect of tints of the patient's choice on patient's reading performance. All groups have tested reading disabled subjects with symptoms considered to be characteristic of the so called "scotopic sensitivity syndrome". Stanley¹⁹ (1987) reported on a study of dyslexic children who were divided into two groups and given coloured overlays to see if there was any improvement in their reading. Some of the chil-

dren showed faster reading after three weeks and others did not (detailed results of this paper are still in press). Stanley concluded that his experience with coloured filters suggests that "... there can be quite real motivational effects produced when coloured filters are used, but the basic problems of reading disability are not removed".

A similar study by Robson and Miles²⁰ demonstrated immediate positive effects on some aspects of reading performance (word matching, letter recognition and number recognition) using coloured overlays. However the subjects word recognition did not improve.

O'Connor and Sofo²¹ investigated the effect of coloured plastic overlays on dyslexic children's reading. The children who were given their preferred overlay colour showed improvement in reading rate and accuracy. Those given clear overlays or non preferred coloured overlays remained essentially unchanged.

In another study, Cheetham and Ovenden²² (1987) assessed 225 dyslexic students who responded to treatment with tinted lenses. Their patients ranged in age from five to 58 years with an average age of 17.1 years. Although their patients reported that tinted lens wear led to more stable print and better separation of words and sustained concentration on reading tasks they concluded that tinted lenses facilitated reading in poor readers but "... did not cure the reading problem". They also stated that it was rare to see a student responding simply to a tint. They suggested that further research is necessary to answer the two questions; does the tinting work, and if so, how does it work?

Winter²³ (1987) tested 15 dyslexic primary school children with Irlen lenses. The children were tested on timed letter identification tasks. No improvement was found for speed or accuracy of performance.

One study from America using tinted lenses on remedial high school students and a matched control group showed significant improvement for timed reading scores and finding a place on a printed page when wearing tinted lenses.²⁴

In a study assessing the effect of wearing tinted lenses for 12 months on 44 dyslexic subjects ranging in age from nine to 14 years, Robinson

and Conway²⁵ showed improvement in reading accuracy and comprehension which was more likely to occur in the first six months. They hypothesised that this improvement could be due to an improvement in visual clarity affecting re-reading (i.e. improved ability to see print on a page by altering the background colour of the page thus reducing the contrast between the print and the background), which thus enhanced spontaneous gains in comprehension. Alternately, improvement may have been due to a placebo effect created by the tinted lenses. They did not formally assess visual clarity or measure visual clarity improvement.

In one study^{26,27} in which the author participated, reading disabled children were assessed by a special education teacher using the Neal Analysis of Reading and were then prescribed tinted lenses. After at least one term at school there was no statistically significant change in reading.

In a recent review article, Wilsher and Taylor¹⁸ suggested that "... dyslexics should differentiate between visual preference (and other psychological factors), affecting the way they see the page after treatment with tinted lenses, and whether they actually improved reading ability. Most people (both normal and dyslexic) may prefer to see the world through rose-coloured glasses but this does not mean that the effects experienced are any more than placebo". They went on to suggest that the psychological effects could be explained in terms such as the attention factor; the patient felt someone was trying to help, the novelty value of seeing the page in a new light, the reduction in anxiety because the previously 'hidden' handicap could now be seen by everyone and would be taken seriously, the belief that the new treatment would help, the increased motivation to read now that they had a new treatment that they thought was going to help after years of failure and the 'glamour' of wearing the glasses.

Similar conclusions may be drawn from another study.²⁶ After three months of wearing tinted lenses reading disabled children's reading performance had shown no statistical improvement but, according to their parents, their self esteem had greatly improved.²⁷

As previously mentioned, Robinson and Conway²⁵ discussed the possibility of placebo effects on the outcome of their study. They suggested that the fact that reading gains in their study occurred in patients wearing either intermediate or optimal tints (despite Irlen's claims that only optimal tints should have the desired effect), could suggest a placebo effect. They suggested that the improved scores were also associated with improved attitudes to school and school tasks. They cited research which suggested that success at school could depend on motivation. If the children were no longer experiencing persistent academic failure, motivation may have been increased.

The finding of subjective reports of improvement after wearing non optimal coloured lenses was indirectly supported by another study on dyslexic patients.²⁶ Results showed that when asked to choose the colour of print overlay which they preferred to read through, the subjects chose one colour for their preferred print overlay and most chose a different colour for their tinted lenses. This suggests that the colour may not be critical.

These findings conflict with Irlen's⁸ suggestion that only the optimal tint would filter out the wavelength of light that was causing the retinal problem found in "scotopic sensitivity syndrome". Thus the finding of improvement with non optimal tinted lenses must beg the question of the placebo effect of the tinted lenses.

In a number of the patients in one study,²⁷ non tinted (clear) lenses were selected as the optimal tints in some cases. Two of the subjects prescribed these lenses reported that they felt better about themselves wearing the lenses and they felt that their reading had improved. Despite this their reading accuracy and comprehension did not improve when assessed with the Neal test. As the clear lenses do not filter out any wavelengths of light or reduce the contrast between the page and the print the use of these lenses raised the possibility of a placebo effect from tinted lens wear.

In the same study there were a large number of the children who virtually gave up wearing the lenses. The parents stated that they lost interest in the lenses. Despite this (and the finding that

there was no improvement in reading accuracy and comprehension after at least three months of tinted lens wear) some of the parents reported that the children were "doing better" when they wore the lenses. One wonders at the extent to which the parents wanted the treatment to work for their children and the subsequent effect that this had on their reports of their children's performance in the lenses. In turn, perhaps to please their parents, a number of the children who gave up wearing their lenses reported that the lenses had "helped their reading but they just did not want to wear them".

In a study into contrast sensitivity in normal and dyslexic children,²⁸ the hypothesis that dyslexic patients' ability to discriminate fine detail was improved by wearing tinted lenses was investigated. If the dyslexic children were better able to resolve fine detail this may be the reason behind the reports of their improved ability to see the print on the page and thus to read when wearing tinted lenses. In order to test this hypothesis normal contrast sensitivity for 325 children and 25 dyslexic children of the same age without tinted lenses was first established. The effect of tinted lenses on contrast sensitivity in the same groups of normals and dyslexics was established. The study clearly demonstrated that this population of dyslexics had normal contrast sensitivity for their age.

Wearing tinted lenses made a white page appear the same colour as the tint, reduced the contrast between the print and the page and reduced the amount of light entering the eye across the spectrum.²⁹ Despite this the results demonstrated that the ability to see the range of spatial frequencies, 1.5 to 18 cycles per degree at the contrasts below 100% was unaffected by wearing tinted lenses in normals and dyslexic children. As normally sized printed text (black letters on a white background at or just under 100% contrast) fell into the range tested³⁰ it may be assumed that sensitivity to print was unaffected by the reduction in contrast induced by tinted lenses wear. (Statistically tinted lens strength and or colour had NO effect on contrast sensitivity (ANCOVA $p > 0.05$) in either the normals or the dyslexics.)

A number of papers have reported tinted lenses improved visual clarity thus reading improved after tinted lens wear.^{8,9,25} They suggested that vision was improved despite the fact that none of the researchers did formal quantitative tests of visual function on the subjects in their studies before or after tinted lens wear. Their suggestions were based on subjective evidence from the patients (i.e. the subjects said that they could see better).

The finding from the study on contrast sensitivity with tinted lenses did NOT support the visual anomaly theories of dyslexia or the "scotopic sensitivity" theory, however, it did not conflict with some of the other theories. If, as strong anatomical evidence suggest,⁴⁻⁶ dyslexia was the result of abnormal brain micro architectural affecting the linguistic processing areas one would not have anticipated that tinted lenses would have had an effect on the ability of dyslexics to see fine print on a page or to read.

CONCLUSIONS

The finding of no improvement in reading after tinted lens wear had been supported by a number of authors.^{18,23,26} However, there is a body of literature that has reported improvement in reading or reading related skills after tinted lens wear or the use of tinted print overlays.^{8,9,11,20-22} Others reported mixed success with the treatment with some cases showing improvement and others showing no improvement.¹⁹

As well as the debate in the literature as to whether or not the treatment works there is a debate as to why tinted lenses may work. The hypothesis put forward included:

- (1) the correct tint filtered out the wavelengths of light to which the person was uniquely sensitive (scotopic sensitivity syndrome);
- (2) the tinted lenses improve the clarity of vision when looking at normal black print on a white page;
- (3) the placebo effect of the lenses.

Analysis of the tinted lenses²⁹ has revealed that tinted lenses only filter out some of the light at any given wavelength. The stronger the tint the more light is filtered out but even with 75% strength some light at ALL wavelengths passes

through the lens. At 15% very little light is filtered out. Thus the hypothesis that tinted lenses filter OUT a band of light may be questioned.

The hypothesis that tinted lenses improve the clarity of vision when looking at normal black print on a white page was not supported in the only study that has quantitatively assessed the effect of tinted lenses on vision and contrast sensitivity.²⁸ The study concluded that any change in reading ability after wearing tinted lenses was not the result of any effect of the lenses on the patients ability to see the print when the contrast between the page and the black letters was reduced by the tinted lens. The other papers that reported improved clarity did not report on any formal assessment of vision at all.

The possibility that the reported change in reading ability with tinted lenses may be related to psychological factors must not be ignored. Certainly by wearing tinted lenses there is a visible identification of the learning difficulty. It may be suggested that the problem has been taken from within and put on the nose.

To date there is no anatomical or physiological evidence that dyslexia is the result of visual anomaly. Although some psychophysical evidence pointed to the visual system it was frequently not substantiated between studies. The majority of the literature pointed towards anatomical anomalies affecting the linguistic processing areas of the brain. As yet there is no treatment for dyslexia which has been both effective and caused 'fast' improvement. If the problem stems from abnormal brain architecture, there may never be a 'cure' for the problem.

The treatment of dyslexia using tinted lenses is a non invasive therapy that cannot physically harm the patient. However, it must be made clear to parents that there is no substantiated evidence that the dyslexic children have a visual problem and even if tinted lenses help they certainly do not cure reading problems.

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