Irlen filters and reading strategies: the effect of coloured filters on reading achievement, specific reading strategies and perception of ability.

Gregory L. Robinson

While recent research has placed less importance on the association between visual difficulties and reading problems, the effects of orthographic representation, especially for phonological awareness cannot be overlooked (Ehri, 1989; Ehri & Wilce, 1985; Foorman & Liberman, 1989; Lovett, 1987; Rourke, 1989; Wagner, 1988).

The possibility that inadequate visual processing is a factor in reading disability has gained further attention as a result of Irlen's (1983) suggestion of a visual, perceptual dysfunction unrelated to those skills normally assessed by eye examination. This dysfunction was considered by Irlen (1983) to be associated with an excess sensitivity of the retina to particular frequencies of the light spectrum. Persons with this dysfunction which Irlen (1983) called Scotopic Sensitivity Syndrome, report print and background distortions when undertaking reading or writing tasks which may include blurring or movement of print, restricted span of recognition, and problems with sustaining focus (Whiting, 1985). Such difficulties are reported despite a full optometric or ophthalmological examination, with appropriate lenses fitted where required. The distortions described by Irlen (1983) and Whiting (1985) are similar to those reported in a number of other investigations (Lovegrove, 1984; Meares, 1980; Stein & Fowler, 1985), especially the problem of restricted span of recognition (Bouma & Legein, 1977; Legein & Bouma, 1982; McIntyre, Murray, Cronin, & Blackwell, 1978).

Irlen (1983) claimed that the distortions reported by subjects with this visual, perceptual dysfunction are lessened by the use of tinted, nonoptical lenses, which filter out those frequencies of the light spectrum to which a person may be uniquely sensitive. Some symptoms reported by subjects, such as doubling and movement of words and shadows or halos around words may suggest a retinal sensory after imaging effect which may be exaggerated by extended reading. The possibility of this effect has been discussed by Riding and Pugh (1977), Sakitt (1976), and Stanley and Hall (1973) who suggested sensory images might persist longer for reading disabled children than for average readers. Such an effect may also be similar to that described by Lovegrove, Martin, and Slaguis (1986) as a deficit in the transient visual subsystem which inhibits the overlapping of visual images between consecutive eye fixations, thereby preventing blurring or doubling.

The transient system is considered to be involved in eye movement and would thus direct the eye to a particular location of words on a page. Once the location has been fixed, another visual system (the sustained system) is
activated to extract the visual detail of letters and words. It is claimed that in some people the visual detail of the sustained system may persist after the eye has moved to a new fixation point, thereby causing overlapping of images (Brannan & Williams, 1988; Solman, Cho, & Dain, 1992; Spafford & Grosser, 1991; Williams & Bologna, 1985; Williams, Brannan, & Latrigue, 1987). With colour filtering, claimed to improve the ability of the transient system to inhibit the visual images of the sustained system (Solman, Dain, & Keech; 1991; Williams, Lecluyse, & Rock Faucheux; 1992).

The sustained and transient systems theory has recently been further revised and incorporated in the conceptual framework of parvocellular and magnocellular processing in the primate visual system (Breitmeyer, 1989; Livingstone & Hubel, 1987). The implication is that dyslexics have an abnormality in the magnocellular subsystem, which normally should act to inhibit the parvocellular system after each saccade, thereby erasing the image of the previous system (Lovegrove, Garzia, & Nicholson, 1990). Livingstone, Rosen, Drislane, and Galaburda (1991) found that reading disabled subjects had diminished evoked potentials for rapid low-contrast stimuli, but normal responses to slow or high-contrast stimuli. Such abnormalities were consistent with a defect in the magnocellular pathway. This possibility was further corroborated in the study by comparing in autopsy brains of five dyslexic and five control persons. Abnormalities were found in the magnocellular but not the parvocellular layers for the dyslexic individuals. Lehmkuhle, Garzia, Turner, Hash and Baro (1993) also reported that visual evoked potentials were larger for eight reading disabled children than 13 normally achieving controls, which was claimed to suggest that the magnocellular visual pathway is slowed for reading disabled children.

A number of studies have investigated the extent to which use of colour filtering will generalise to improved reading achievement. While these studies have produced more positive than negative results, there has been criticism of all studies for lack of methodological soundness (Lea & Hailey, 1990; Stanley, 1990). Initial investigations used coloured transparencies rather than the full Irlen procedure. Two positive studies were reported, with O'Connor, Sofo, Kendall, and Olsen (1990) showing significant gains in rate, accuracy and comprehension of reading and Robinson and Miles (1987) finding significantly higher mean scores for word matching, letter recognition and number recognition tasks. Saint John and White (1988) however found no significant differences in rate or accuracy of reading for 11 poor readers, although they were not screened for symptoms of scotopic sensitivity and thereby may not have been responsive to the use of colour (Howell & Stanley, 1988).

Recent investigations of the effect of colour filtering on reading have tended to use the full Irlen procedure rather than coloured transparencies, with positive results being obtained in nine studies, negative results obtained in three studies, and mixed results reported in
two studies. The positive studies reported significant improvements in rate, accuracy and comprehension of reading over periods of four to two years of use (Adler & Attwood, 1987; Fricker, 1989; Hannell, Gole, Dibden, Rooney, Pidgeon, & McGlinchey, 1989; Kreuttner & Strum, 1990; Robinson & Conway, 1989), with surveys of Irlen lens users reporting approval ratings of 82% to 93% over one to twelve months of use (Burgess, 1990; Irlen, 1983; McLachlan, Yale, & Wilkins, in press; Whiting & Robinson, 1988). The mixed result studies reported significant improvement in some reading subskills but not in others (Blaskey, Scheiman, Parisi, Ciner, Gallaway, & Selznick, 1990; Kyd, Sutherland, & McGettrick, 1992). The negative result studies did not find improvement in a timed letter recognition task (Winter, 1987), or significant gains in rate, accuracy and comprehension of reading when assessed immediately (Cotton & Evans, 1990), and over one school term of use (Gole, Dibden, IPearson, Pidgeon, Hannell, Fitzgerald, Kortman, & McGlinchey, 1989).

In addition to studies of the effects of colour on reading achievement, positive results have also been reported for reducing the number of eye fixations and regressions per line of print while reading (Holland, Tyrrell, & Wilkins, 1991), for visual search tasks and binocular coordination (Wilkins & Neary, 1991), and for eye strain from fluorescent lighting (Wilkins & Wilkinson, 1991).

While many studies have produced positive results and there have been numerous anecdotal reports of beneficial effects for some individuals, the findings do not fully settle the issue of possible causal mechanisms or of positive and enduring effects for reading achievement. The discrepancies in findings may reflect that print distortions reported by experimental subjects in many studies may not be the only factor in poor reading achievement. A similar conclusion (due to discrepant results) has been reached for the likely influence of optical defects on reading achievement (Bond, Tinker, & Wasson, 1979; Spache, 1976), with more recent studies (Simons & Grisham, 1987; Stolzenberg, Ritty, Cohen, & Liebegmann, 1989) suggesting that binocular abnormalities may, for some children, be only one contributing factor in reading difficulty. Other possible factors may include poor word recognition skills, which may still need to be developed once print distortions are reduced (Blaskey, et al. 1990; Kyd, et al. 1992; Robinson, 1990; Robinson & Conway, 1990), as well as willingness and motivation to read (Wong, 1986). Established reading strategies such as guessing of words from single letter cues may also restrict the development of phonics analysis (Robinson & Conway, 1990). Such strategies may have been developed to compensate for word identification problems (Bouma & Legein, 1980; Mazer, McIntyre, Murray, Till, & Blackwell, 1983).

The reduction in the span of visual recognition reported by many users of Irlen lenses (Ir
len, 1983, Robinson & Conway, 1990) may be of particular importance. Reduced span may hinder word recognition and comprehension as prior parafoveal exposure can influence the identification of a fixated word (Jennings & Underwood, 1984, Legein & Bouma, 1982) and may also influence (in conjunction with semantic context) the guidance of eye fixations needed for flexible scanning to process meaning (Fisher & Shebliske, 1985). Poor readers have been found to have a restricted field of vision (Eames, 1957) and to make significantly more fixations and backward regressions per line than normal readers (Foss & Hakes, 1978; Griffin, Walton, & Ives, 1974; Mazer et al. 1983; Pavlides, 1985). The number of fixations and regressions has been reported to improve for users of Irlen lenses (Holland, et al. 1991). It could be hypothesised that a reduced span of recognition may hinder the organisation of text into meaningful phrase units by restricting word identification and limiting the flexibility of eye fixations needed to process meaning.

This hypothesis may be supported by investigations which report that readers with poor speed and accuracy have difficulty identifying meaningful phrase units (Clay & Imlach, 1971; Lovett, 1986), which could restrict the effective integration of text for comprehension (Lovett, 1986). Studies of the effects of Irlen filters have indicated increases in reading speed and comprehension (Adler & Attwood, 1987; Fricker, 1989; Robinson & Conway, 1990) which could imply that increased speed of word identification may facilitate comprehension, as words need to be identified quickly so that word groupings which denote units of meaning can be formed before words fade from short term memory (Andrews, 1989; Bresnitz, 1987; Just & Carpenter, 1980; Kirby & Williams, 1991; Liberman & Shankweiler, 1985; Lunzer & Gardiner, 1979; Oakhill & Garnham, 1988). The restriction in span of recognition and other distortions of print reported by users of Irlen lenses may lead to slow, word-by-word recognition as previously discussed, which could limit the use of semantic context and restrict meaningful integration of text. Conversely, reductions in such distortions may facilitate reading fluency and in turn give greater access to semantic context for comprehension and word identification.

A more recent study of reading achievement by Robinson and Conway (1994), as well as two investigations of comprehension monitoring would tend to support the above contention (Cohan & Robinson, 1989, Chan & Robinson, 1990). Chan and Robinson, (1989) found 20 disabled readers wearing Irlen lenses did not appear to need specific comprehension instruction, while 20 non-Irlen candidate poor readers did. It was suggested that the claimed reductions in print distortions for Irlen lens users allowed more attention to be directed to processing text meaning rather than to letter and word identification, thus reducing the necessity for specific comprehension instructions. A further study of the effects of comprehension monitoring by Chan and Robinson (1990) found that subjects fitted with Irlen lenses for 6 months (N=10) were on average 9 months ahead on reading accuracy an
Two experimental groups of subjects were compared to two control groups. One control group was yet to receive lenses (N=10) and one had reading problems, but no response to colour (N=10). Subjects fitted with Irlen lenses for two months (N=10) were on average 5 months ahead in comprehension compared to the control groups.

The study by Robinson and Conway (1994) not only found significant increases in reading rate and comprehension for 29 poor readers fitted with Irlen lenses compared to 31 poor reading controls, but also significantly less pauses while reading and a significant increase in word reading. The gains in reading rate and comprehension again suggest that the reported reductions in print distortions may facilitate fluency, which in turn could provide more working memory space for the processing of continuous text rather than for the identification of individual words, thereby providing greater extraction of meaning (Andrews, 1989; Breznitz, 1987; Daneman & Carpenter, 1980; Juel, Griffith, & Gough, 1986; Kirby & Williams, 1991; LaBerge & Samuels, 1974; Lovett, 1987; Perfetti, 1985; Stanovich, 1980, 1981, 1986; Wong, 1986). An increase in capacity to monitor meaning may also increase access to text context as a supplement to word recognition (Stanovich, 1986) or as a means of compensating for other word attack deficiencies (Bruck, 1988; Bouma & Legein, 1989).

The significant reduction in number of pauses while reading for the experimental group in the Robinson and Conway (1994) study would also be consistent with findings of increases in performance on visual search tasks using print (Holland, et al., 1991; Wilkins & Neary, 1991). The reduction in frequency of pauses could suggest that the experimental group is a visually based subgroup with a slower response latency for visual stimuli (Bouma & Legein, 1980; Lovett, 1987; Mazer, et al., 1983; Rourke, 1989), who respond to colour filters. The concept of a slower response latency as a causal factor in reading difficulty is also consistent with the notion of a magnocellular defect in the visual pathway (Lehmkuhle, et al., 1993; Livingstone, et al., 1991) and with the possibility of a transient visual subsystem deficit which may be influenced by colour filters (Solman, et al., 1991; Williams, et al., 1992).

The significant increase in word reading in the Robinson and Conway (1994) study could further be linked to the hypothesized facilitative effects of Irlen lenses on span of recognition, use of semantic context and meaningful integration of text. Increased span allows prior exposure to words, which may facilitate word recognition and the guidance of eye fixations for comprehension (Fisher & Shebliske, 1985). This in turn may assist the identification of meaningful phrases as units in reading (Clay & Imlach, 1971; Lovett, 1986) and facilitate integration of text (Andrews...
Holland, et al. (1991) found a significant reduction in the number of eye fixations and regressions per line of print when using preferred colour filters.

While there is still much to be learnt about the causes and effects of colour filtering, the studies reviewed make it difficult to ignore visual processing as a variable in reading achievement, with colour being a potential intervention factor. However not all studies of reading achievement were positive, which emphasises the fact that reducing print distortions, whether by optometric prescription or colour, is likely to be only one factor in reading development.

As with other areas of learning disability, there is need for a much greater investigation of the complex, reciprocal links between learning problems and emotional, motivational and strategic factors. The "non obvious" nature of many learning disabilities has meant that their acceptance and investigation has been too long ignored and we are now faced with heightened public awareness of an area in which there are still many gaps in our knowledge.

REFERENCES


The effective use of reading.


On becoming a skilled reader. London: Blackwell. p.00*6


The effect of *Irlen colored lenses on specific reading skills and perception of ability: a twelve month validity study. Journal of Learning Disabilities, 23588, +%0 597. p00*6


M Effective interventions for reading disability. Journal of the American Optometri...