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

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While recent research has placed less importance on the association between visual difficulties and reading problems, the effects of orthographic representation, especially forIphonological awareness cannot be overlooked (Ehri, 1989; EhriI& Wilce, 1985; Foorman & Liberman, 1989; Lovett, 1987; Rourke,I1989; Wagner, 1988). ï

The possibility that inadequate visual processing is aIfactor in reading disability has gained further attention as aIresult of Irlen's (1983) suggestion of a visual,perceptualIdysfunction unrelated to those skills normally assessed byIeye 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.IPersons with this dysfunction which Irlen (1983) calledIScotopic Sensitivity Syndrome, report print and backgroundIdistortions when undertaking reading or writing tasks whichImay include blurring or movement of print, restricted span of recognition, and problems with sustaining focus (Whiting,I1985). Such difficulties are reported despite a fullIoptometric or opthalmological examination, with appropriateIlenses 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 ofIrestricted span of recognition (Bouma & Legein, 1977; Legein &IBouma, 1982; McIntyre, Murray, Cronin, & Blackwell, 1978).

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

The transient system is considered to be involved in eyeImovement and would thus direct the eye to a particularIlocation of words on a page. Once the location has been fixed,Ianother visual system (the sustained system) is

activated toIextract the visual detail of letters and words. It is claimedIthat in some people the visual detail of the sustained systemImay persist after the eye has moved to a new fixation pointIthereby causing overlapping of images (Brannan & Williams,I1988, Solman, Cho, & Dain, 1992; Spafford & Grosser, 1991;IWilliams & Bologna, 1985; Williams, Brannan, & Latrigue, 1987;Iwith colour filtering, claimed to improve the ability of theItransient system to inhibit the visual images of the sustainedIsystem (Solman, Dain, & Keech; 1991, Williams, Lecluyse, & Rock Faucheux; 1992).

The sustained and transient systems theory has recentlyIbeen further revised and incorporated in the conceptualIframework of parvocellular and magnocellular processing in theIprimate visual system (Breitmeyer, 1989; Livingstone & Hubel,I1987). The implication is that dyslexics have an

abnormalityIin the magnocellular subsystem, which normally should act toIinhibit the parvocellular system after each saccade, therebyIerasing the image of the previous system (Lovegrove, Garzia, &INicholson, 1990). Livingstone, Rosen, Drislane, and GalaburdaI(1991) found that reading disabled subjects had diminishedIevoked potentials for rapid low,contrast stimuli, but normalIresponses to slow or high, contrast stimuli. Such abnormalitiesIwere consistent with a defect in the magnocellular pathway.IThis possibility was further corroborated in the study byIcomparing in autopsy brains of five dyslexic and five control persons. Abnormalities were found in the magnocellular butInot the parvocellular layers for the dyslexic individuals.ILehmkuhle, Garzia, Turner, Hash and Baro (1993) also reportedIvisual evoked potentials were larger for eight readingIdisabled children than 13 normally achieving controls, whichIwas claimed to suggest that the magnocellular visual pathway is slowed for reading disabled children.

A number of studies have investigated the extent to whichIuse 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 studiesIfor lack of methodological soundness (Lea & Hailey, 1990; Stanley, 1990). Initial investigations used coloured transparencies rather than the full Irlen procedure. TwoIpositive studies were reported, with O'Connor, Sofo, Kendall,Iand Olsen (1990) showing significant gains in rate, accuracyIand comprehension of reading and Robinson and Miles (1987)Ifinding significantly higher mean scores for word matching,Iletter recognition and number recognition tasks. Saint JohnIand White (1988) however found no significant differences inIrate or accuracy of reading for 11 poor readers, although theyIwere not screened for symptoms of scotopic sensitivity andIthereby may not have been responsive to the use of colour (Howell & Stanley, 1988).

Recent investigations of the effect of colour filteringIon reading have tended to use the full Irlen procedure ratherIthan coloured transparencies, with positive results being obtained in nine studies, negative results obtained in threeIstudies, and mixed results reported in

two studies. The positive studies reported significant improvements in rate,Iaccuracy and comprehension of reading over periods of fourImonths to two years of use (Adler & Attwood, 1987; Fricker,I1989; Hannell, Gole, Dibden, Rooney, Pidgeon, & McGlinchey,I1989; Kreuttner & Strum, 1990; Robinson & Conway, 1990), withIsurveys of Irlen lens users reporting approval ratings of 82%Ito 93% over one to twelve months of use (Burgess, 1990; Irlen,I1983; McLachlan, Yale, & Wilkins, in press; Whiting &IRobinson, 1988). The mixed result studies reported significantIimprovement in some reading subskills but not in others (Blaskey, Scheiman, Parisi, Ciner, Gallaway, & Selznick, 1990; Kyd, Sutherland, & McGettrick, 1992). The negative resultIstudies did not find improvement in a timed letter recognitionItask (Winter, 1987), or significant gains in rate, accuracyIand comprehension of reading when assessed immediately (CottonI& 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 reportedIfor reducing the number of eye fixations and regressions perIline of print while reading (Holland, Tyrrell, & Wilkins,I1991), for visual search tasks and binocular coordinationI(Wilkins & Neary, 1991), and for eye strain from fluorescentIlighting (Wilkins & Wilkinson, 1991).

While many st
udies have produced positive resultsIand there have been numerous anecdo
tal reports of beneficialIeffects for some individuals, the findings to d

ate do notIfully settle the issue of possible causal mechanisms or ofIpo
sitive and enduring effects for reading achievement. TheIdiscrepancies i
n findings may reflect that print distortionsIreported by experimental s
ubjects in many studies may not beIthe only factor in poor reading achi
evement. A similarIconclusion (due to discrepant results) has been reach
ed forIthe likely influence of optical defects on reading achievementI(B
ond, Tinker, & Wasson, 1979; Spache, 1976), with more recentIstudies (Si
mons & Grisham, 1987; Stolzenberg, Ritty, Cohen, &ILiebegmann, 1989) sug
gesting that binocular abnormalities may,Ifor some children, be only one
contributing factor in reading difficulty. Other possible factors may include poor wordIrecognition skills, which may still need to be developed onceIprint distortions are reduced (Blaskey, et al. 1990; Kyd, et al. 1992; Robinson, 1990; Robinson & Conway, 1990), as well asIwillingness and motivation to read (Wong, 1986). EstablishedIreading strategies such as guessing of words from singleIletter cues may also restrict the development of phonicIanalysis (Robinson & Conway, 1990). Such strategies may haveIbeen developed to compensate for word identification problemsI(Bouma & Legein, 1980; Mazer, McIntyre, Murray, Till, & Blackwell, 1983).

The reduction in t
he span of visual recognition reportedIby many users of Irlen lenses (Ir

len, 1983, Robinson & Conway,I1990) may be of particular importance. Red
uced span may hinderIword recognition and comprehension as prior parafo
vealIexposure can influence the identification of a fixated wordI(Jennin
gs & Underwood, 1984, Legein & Bouma, 1982) and mayIalso influence (in c
onjunction with semantic context) theIguidance of eye fixations needed f
or flexible scanning toIprocess meaning (Fisher & Shebliske, 1985). Poor
readers have Ibeen found to have a restricted field of vision (Eames, 1
957)Iand to make significantly more fixations and backwardIregressions p
er line than normal readers (Foss & Hakes, 1978;IGriffin, Walton, & Ives
, 1974; Mazer et al. 1983; Pavlides, 1985). The number of fixations a
nd regressions has beenIreported to improve for users of Irlen lenses (H
olland, 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 andIlimit
ing the flexibility of eye fixations needed to processImeaning.

This hypothesis may be supported by investigations whichIreport that
readers with poor speed and accuracy haveIdifficulty identifying meaningful
phrase units (Clay & Imlach,I1971; Lovett, 1986), which could restrict the
effectiveIintegration of text for comprehension (Lovett, 1986). StudiesIof
the effects of Irlen filters have indicated increases inIreading speed a
nd comprehension (Adler & Attwood, 1987;IFricker, 1989; Robinson & Conwa
y, 1990) which could imply thatIincreased speed of word identification m
ay facilitateIcomprehension, as words neeed to be identified quickly so t
hatIword groupings which denote units of meaning can be formedIbefore wo
rds fade from short term memory (Andrews, 1989;IBresnitz, 1987; Just & C
arpenter, 1980; Kirby & Williams,I1991; Liberman & Shankweiler, 1985; Lu
nzer & Gardiner, 1979;IOakhill & Garnham, 1988). The restriction in span
ofIrecognition and other distortions of print reported by usersIof Irle
n lenses may lead to slow, word,by,word recognition asIpreviously discus
sed, which could limit the use of semanticIcontext and restrict meaningf
ul integration of text.IConversely, reductions in such distortions may f
acilitateIreading fluency and in turn give greater access to semanticIco
ntext for comprehension and word identification.

A more recent study of reading achievement by RobinsonIand Conway (1994),
as well as two investigations ofIcomprehension monitoring would tend to
support the above
contention (Cohan & Robinson, 1989, Chan & Robinson, 1990). ICha
n and Robinson, (1989) found 20 disabled readers wearingIIrlen lenses di
d not appear to need specific comprehensionIinstruction, while 20 non,Ir

len candidate poor readers did. IIt was suggested that the claimed reduc
tions in printIdistortions for Irlen lens users allowed more attention t
o beIdirected to processing text meaning rather than to letter andIword i
dentification, thus reducing the necessity for specificIcomprehension in
structions. A further study of the effects ofIcomprehension monitoring b
y Chan and Robinson (1990) foundIthat subjects fitted with Irlen lenses f
or 6 months (N=10)Iwere on average 9 months ahead on reading accuracy an

d 12Imonths ahead in reading comprehension than two non controlIgroups. O
ne control group was yet to receive lenses (N=10)Iand one had reading pr
oblems, but no response to colourI(N=10). Subjects fitted with Irlen le
nses for two monthsI(N=10) were on average 5 months ahead in comprehensi
on whenIcompared to the control groups.

The study by Robinson and Conw
ay (1994) not only foundIsignificant increases in reading rate and compr
ehension for 29Ipoor readers fitted with Irlen lenses compared to 31 poo
rIreading controls, but also significantly less pauses whileIreading and
a significant increase in word re,reading. TheIgains in reading rate a
nd comprehension again suggest thatIreported reductions in print distort
ions may facilitateIfluency, which in turn could provide more working me
mory spaceIfor the processing of continuous text rather than for theIide
ntification of individual words, thereby providing greater
extraction of meaning (Andrews, 1989; Breznitz, 1987; DanemanI& Carp
enter, 1980; Juel, Griffith, & Gough, 1986; Kirby &IWilliams, 1991; LaBe
rge & Samuels, 1974; Lovett, 1987;IPerfetti, 1985; Stanovich, 1980, 1981
, 1986; Wong, 1986). AnIincrease in capacity to monitor meaning may also
increaseIaccess to text context as a supplement to word recognitionI(St
anovich, 1986) or as a means of compensating for other wordIattack defic
iencies (Bruck, 1988; Bouma & Legein, 1980).

The significant reduction in number of pauses whileIreading for th
e experimental group in the Robinson and ConwayI(1994) study would also b
e consistent with findings ofIincreases in performance on visual search t
asks using printI(Holland, et al.,1991; Wilkins & Neary, 1991). The r
eductionIin frequency of pauses could suggest that the experimentalIgro
up are a visually based subgroup with a slower responseIlatency for visu
al stimuli (Bouma & Legein, 1980; Lovett,I1987; Mazer, et al., 1983;
Rourke, 1989), who respond toIcolour filters. The concept of a slower r
esponse latency as aIcausal factor in reading difficulty is also consist
ent withIthe notion of a magnocellular defect in the visual pathwayI(Leh
mkuhle, et al, 1993; Livingstone, et al., 1991) and withIthe pos
sibility of a transient visual subsystem deficit whichImay be influenced
by colour filters (Solman, et al., 1991;IWilliams, et al., 1992).

The significant increase in word re,reading in theIRobinson and Con
way (1994) study could further be linked toIthe hypothesized facilitativ
e effects of Irlen lenses on spanIof recognition, use of semantic contex
t and meaningful integration of text. Increased span allows prior exposure
to words, which may facilitate word recognition and the guidanceIof eye
fixa
tions for comprehension (Fisher & Shebliske, 1985).IThis in turn may ass
ist the identification of meaningfulIphrases as units in reading (Clay &
Imlach, 1971; Lovett,I1986) and facilitate integration of text (Andrews

, 1989).IHolland, et al. (1991) found a significant reduction in the Inumber of eye fixations and regressions per line of print whenIusing pr eferred colour filters.

While there is still much to be learnt about t

he causesIand effects of colur filtering, the studies reviewed make itId ifficult to ignore visual processing as a variable in readingIachievemen t, with colour being a potential interventionIfactor. However not all s tudies of reading achievement wereIpositive, which emphasises the fact t hat reducing printIdistortions, whether by optometric prescription or co lour, isIlikely to be only one factor in reading development.

As with o
ther areas of learning disability, there is needIfor a
much greater investigation of the complex, reciprocalIlinks betwe
en learning problems and emotional, motivationalIand strategic factors. T
he "non obvious" nature of manyIlearning disabilities has meant that the
ir acceptance andIinvestigation has been too long ignored and we are now
facedIwith heightened public awareness of an area in which there areIst
ill many gaps in our knowledge.

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