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Literature search results

Search completed for:	
Search required by:	Mid-October
Search completed on:	7th October 2014
Search completed by:	Richard Bridgen / Janet Badcock

Search details
Colorimetry – is it the best way of assessing for coloured ot tinted lenses?

Resources searched
NICE Evidence; TRIP Database; Cochrane Library; AMED; BNI; CINAHL; EMBASE; HMIC; MEDLINE; PsychINFO; Google Scholar; Google Advanced Search ***Database search terms**:* lens*; overlay*; filter*; precision; tint*; color*; colour*; already; exact*; prescri*; accurat*; custom*; bespoke; "made to order"; pre; "standard set"; exp COLOR VISION DEFECTS; disorder*; defect*; problem*; disease* ***Evidence / Google Scholar search string(s)**:* (coloured OR colored OR color OR colour OR tinted) (lens OR overlays OR filters) (prescribed OR prescription OR precision OR "to order" OR "standard set" OR pre OR "already made") ("vision disorder" OR "colour defects") (coloured OR colored OR color OR colour OR tinted) (lens OR overlays OR filters) (prescribed OR prescription OR precision OR "to order" OR "standard set" OR pre OR "already made") ("vision disorder" OR "vision defects" OR "colour defects" OR "colour disorders" OR "colour vision")

Summary
There is some research on the use of prescribed and non-prescribed coloured lenses, overlays or filters, much of it now quite dated; however there are a couple of papers published in the last couple of years.

Guidelines and Policy

None found.

Evidence Reviews

NHS Choices

Colour vision deficiency 2014

Published Research – Databases

Subsequent search

Irlen syndrome: expensive lenses for this ill defined syndrome exploit patients

BMJ2014; 349 doi: http://dx.doi.org/10.1136/bmj.g4872(Published 19 September 2014)

From its discovery 35 years ago, Irlen has been the subject of scrutiny and criticism from a number of groups, particularly optometrists, who have sometimes suggested that the Irlen Method is not supported by scientific research and that the problems associated with Irlen Syndrome can be corrected through standard optometric interventions. Research has shown that binocular and accommodative anomalies may occur in conjunction with the syndrome, but are not considered to be the underlying physiological basis of the condition (Evans, Patel, Wilkins, Lightstone, Eperjesi, Speedwell et al., 1999; Evans, Wilkins, Brown, Busby, Wignfield, Jeanes, & Bald, 1996; Evans, Wilkins, Busby, & Jeanes, 1996; Scott, McWhinnie, Taylor, Stevenson, Irons, Lewis et al., 2002). Irlen has also been reviewed by various USA Boards of Optometry and the USA Medical Board and was found not to be either the practice of optometry or medicine. As a perceptual problem, it is similar to other processing problems (both visual and auditory) that are diagnosed by psycho-educational testing and treated within the educational system.

When it comes to research, often individuals who say Irlen is not supported by research are uninformed, citing second-hand positions based on research that is more than 20 years old. Specifically, early critics of the research have said that it does not control for placebo effects or experimenter bias, and that it lacks validity and reliability. However, there are more than 100 scientific research studies on the topic of Irlen Syndrome that are published in peer-reviewed scientific journals. These studies have most often been conducted by independent researchers with no financial investment in the method. This research has established a hereditary component of the disorder (Loew & Watson, 2012; Robinson, Foreman, & Dear, 2000; Robinson, Foreman, Dear & Sparkes, 2004), a number of biochemical markers for problems associated with Irlen Syndrome (Robinson, Roberts, McGregor, Dunstan, & Butt, 1999; Robinson, McGregor, Roberts, Dunstan & Butt, 2001; Sparkes, Robinson, Dunstan, & Roberts, 2003), and differences between both the anatomy and functioning of brains of individuals with Irlen Syndrome (Chouinard, Zhou, Hrybousky, Kim, & Commine, 2012; Huang, Zong, Wilkins, Jenkins, Bozoki, & Cao, 2011; Lewine, Davis, Provencal, Edgar, & Orrison, 1997; Riddell, Wilkins, & Hainline, 2006; Yellen & Schweller, 2009). The research has repeatedly documented efficacy of both colored overlays and spectral filters, as measured by improvements in a variety of reading skills (Bouldoukian, Wilkins, & Evans, 2002; Nobel, Orton, Irlen & Robinson, 2004; Park, Kim, Cho, Joo, 2012; Robinson & Foreman, 1999; Tyrrell, Holland, Dennis, & Wilkins, 1995; Williams, LeCluyse, & Rock Faucheux, 1992; Wilkins, Evans, Brown, Busby, Wingfield, Jeanes & Bald, 1994), reduction in physical symptoms that include headaches, migraines, eye strain, fatigue, and light sensitivity (Barbolini, Lazzerini, Pini, Steiner, Del Cecchio, Migaldi, & Cavallini, 2009; Bulmer, 1994; Chronicle & Wilkins, 1991; Huang et al., 2011; Wilkins & Wilkinson, 1991), and improved functioning and success in both academia and the workplace (Bulmer, 1994; Irlen & Robinson, 1996; Robinson & Conway, 1994; Robinson & Conway, 2000; Whiting & Robinson, 1988; Whiting, Robinson, & Parrot, 1994).

Over the years, there have also been a few studies that offered negative results, and these limited studies have often been cited as the support for dismissing the validity of Irlen. However, these negative studies have been critiqued in the literature for their methodological flaws (Robinson, 1994; Robinson, Foreman, & Dear, 2000), which include not controlling for uncorrected optometric problems, utilizing inappropriate outcome measures, and, the most egregious error, not screening for Irlen Syndrome to ensure they have selected an appropriate sample for the study. In addition, most of the researchers who published negative findings in the early days of research on the topic have subsequently published positive research and have become some of the strongest proponents of colored filters and colored overlays. These individuals have, in many cases, begun prescribing colored filters and overlays in their own practices.

While admittedly frustrated by the controversy that seeks to prevent a research-based, non-invasive, and easily implementable intervention from reaching individuals who need it most, we find that with controversy comes the drive to continue to advance our technology and document its validity. We continue to push forward in the face of adversity because of the millions of individuals we have helped and for the millions of children and adults who have yet to be helped.

Sincerely,
Sandra I. Tosta, Ph.D.
Irlen Institute International Headquarters

1. Precision-tinted coloured filters: A successful intervention for medically resistant headaches and migraines after brain injury

Author(s) Tosta S., Irlen H., Lewine J., Annibali J.

Citation: Brain Injury, May 2014, vol./is. 28/5-6(683), 0269-9052 (May 2014)

Publication Date: May 2014

Abstract: Background: Since March 2011, Irlen has been investigating the use of Irlen Spectral Filters with military personnel experiencing chronic light senstivity, headaches and migraines as a result of brain or head trauma that has not been successfully remediated through other interventions, including migraine medications, acupuncture, chiropractic treatments, healing touch, yoga, meditation, vestibular therapy, Botox injections, hyperbaric and Neurofeedback. Methods: A sample of 134 Military personnel diagnosed with medically resistant headaches and migraines and chronic light sensitvity as a result of combat-related brain or head trauma were seen at the Irlen Institute for treatment. A preliminary questionnaire determined the severity and frequency of headaches and migraines experienced and difficulties related to 28 areas of functioning. The individualized, precision-tinted Irlen Spectral Filter was determined and given to each individual to wear in the form of glasses. After ~4-12 weeks, a follow-up survey was conducted to assess reduction of light sensitivity, headaches and migraines and a variety of other areas. Amount and severity of difficulties experienced were reported on a 0-5 scale (0 means 'no problem' and 5 means 'considerable problem'). Results: Results confirmed a nearly 100% reduction in headaches and migraines, 98% reduction in light sensitivity, 80% reduction in weekly/monthly migraine medication use, 99% reduction in weekly/ monthly OTC medication use, 88-95% reduction in other physical symptoms (eye strain, dizziness, nausea), 93-97% reduction in academic difficulties (reading, math computation, copying, paperpencil tasks, computer, job performance), 75-98% reduction in physical difficulties (co-ordination, balance, depth perception, general perception, tracking moving objects, marksmanship) and 54-64% reduction in emotional symptoms not related to PTSD (anxiety, irritability/agitation, anger, depression). Paired samples t-tests confirmed all improvements were significant at $p<0.05$. Conclusions: For individuals who have suffered head trauma resulting in light sensitivity and chronic headaches and migraines that fail to respond to other standard interventions, Irlen Spectral Filters provide dramatic and immediate relief and improvements. These improvements extend beyond headaches and migraines to impact other areas of life and daily functioning that are crucial to both their ability to remain in active duty and to achieve success after retiring from the Marine Corps. Irlen Spectral Filters are able to eliminate the pain and discomfort that no other intervention or medication has been able to eliminate, provide stability and clarity in the visual field (both on the printed page and in the environment) and improve functioning in more than 26 areas. Sunglasses, tinted lenses, transition lenses, medications and alternative therapies

did not reduce or eliminate their chronic headaches and migraines and other symptoms. Determination of the precise hue and density of the various wavelengths of light must be individually determined in order to eliminate headaches, migraines and other symptoms and improve the ability to function.

Source: EMBASE

2. Visual stress symptoms secondary to stroke alleviated with spectral filters and precision tinted ophthalmic lenses: A case report

Author(s) Beasley I.G., Davies L.N.

Citation: Clinical and Experimental Optometry, January 2013, vol./is. 96/1(117-120), 0816-4622;1444-0938 (January 2013)

Publication Date: January 2013

Abstract: Visual stress is a condition characterised by symptoms of eyestrain, headaches and distortions of visual perception when reading text. The symptoms are frequently alleviated with spectral filters and precision tinted ophthalmic lenses. Visual stress is thought to arise due to cortical hyperexcitability and is associated with a range of neurological conditions. Cortical hyperexcitability is known to occur following stroke. The case presented describes visual stress symptoms resulting from stroke, subsequently managed with spectral filters and precision tinted ophthalmic lenses. The case also highlights that the spectral properties of the tint may need to be modified if the disease course alters. 2012 The Authors. Clinical and Experimental Optometry 2012 Optometrists Association Australia.

Source: EMBASE

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3. A comparison of two-coloured filter systems for treating visual reading difficulties.

Author(s) Hall R, Ray N, Harries P, Stein J

Citation: Disability & Rehabilitation, 2013, vol./is. 35/26(2221-6), 0963-8288;1464-5165 (2013)

Publication Date: 2013

Abstract: PURPOSE: Visual disturbances that make it difficult to read text are often termed "visual stress". Coloured filters in spectacles may help some children overcome reading problems that are often caused by visual stress. It has been suggested that for optimal effect each child requires an individually prescribed colour for each eye, as determined in systems such as the "Harris Foundation" coloured filters. Alternatively, it has been argued that only blue or yellow filters, as used in the "Dyslexia Research Trust" (DRT) filter system, are necessary to affect the underlying physiology.METHOD: A randomised, double blind trial with 73 delayed readers, was undertaken to compare changes in reading and spelling as well as irregular and non-word reading skills after 3 months of wearing either the Harris or the DRT filters.RESULTS: Reading improved significantly after wearing either type of filter ($t=-8.4$, $p<0.01$), with 40% of the children improving their reading age by 6 months or more during the 3 month trial. However, spelling ability ($t=2.1$, $p=0.05$) and non-word reading ($f=4.7$, $p<0.05$) improved significantly more with the DRT than with the Harris filters.CONCLUSION: Education and rehabilitation professionals should therefore, consider coloured filters as an effective intervention for delayed readers experiencing visual stress.IMPLICATIONS FOR REHABILITATION: Any disability that impacts on a child's capacity to read has serious implications for academic development as well as the ability to participate independently in activities of daily living. One reading disability, generally termed "visual stress", is related to visual disturbances that make it difficult to read text. This research demonstrates the beneficial use of coloured filters for promoting visual reading capacity for children with visual stress. Professionals who are involved in the needs of children with reading delay, may like to consider the benefits that coloured filters can afford children with visual reading problems.

Source: Medline

4. Irlen colored overlays do not alleviate reading difficulties.

Author(s) Ritchie SJ, Della Sala S, McIntosh RD

Citation: Pediatrics, October 2011, vol./is. 128/4(e932-8), 0031-4005;1098-4275 (2011 Oct)

Publication Date: October 2011

Abstract: OBJECTIVES: To test the efficacy of Irlen colored overlays for alleviating reading difficulties ostensibly caused by Irlen syndrome, a proposed perceptual disorder with controversial diagnostic status.PARTICIPANTS AND METHODS: Sixty-one schoolchildren (aged 7-12 years) with reading difficulties were assessed by an Irlen diagnostician. We used a within-subject study design to examine differences in reading rate across 3 conditions: using an overlay of a prescribed color; using an overlay of a nonprescribed color; and using no overlay. In a subset of 44 children, all of whom had a diagnosis of Irlen syndrome, we also used a between-group design to test the effects of Irlen colored overlays on a global reading measure.RESULTS: The Irlen diagnostician diagnosed Irlen syndrome in 77% of our poor readers. We found no evidence for any immediate benefit of Irlen colored overlays as measured by the reading-rate test or the global reading measure.CONCLUSIONS: Our data suggest that Irlen colored overlays do not have any demonstrable immediate effect on reading in children with reading difficulties.

Source: Medline

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Available in *fulltext* from *Pediatrics* at *Free Access Content*

Available in *fulltext* from *Pediatrics* at *American Academy of Pediatrics*

5. Age related macular degeneration and visual disability

Author(s) Christoforidis J.B., Tecce N., dell'Omo R., Mastropasqua R., Verolino M., Costagliola C.

Citation: Current Drug Targets, July 2011, vol./is. 12/2(221-233), 1389-4501;1873-5592 (July 2012)

Publication Date: July 2011

Abstract: Age-related macular degeneration (AMD) is the leading cause of central blindness or low vision among the elderly in industrialized countries. AMD is caused by a combination of genetic and environmental factors. Among modifiable environmental risk factors, cigarette smoking has been associated with both the dry and wet forms of AMD and may increase the likelihood of worsening pre-existing AMD. Despite advances, the treatment of AMD has limitations and affected patients are often referred for low vision rehabilitation to help them cope with their remaining eyesight. The characteristic visual impairment for both forms of AMD is loss of central vision (central scotoma). This loss results in severe difficulties with reading that may be only partly compensated by magnifying glasses or screen-projection devices. The loss of central vision associated with the disease has a profound impact on patient quality of life. With progressive central visual loss, patients lose their ability to perform the more complex activities of daily living. Common vision aids include low vision filters, magnifiers, telescopes and electronic aids. Low vision rehabilitation (LVR) is a new subspecialty emerging from the traditional fields of ophthalmology, optometry, occupational therapy, and sociology, with an ever-increasing impact on the usual concepts of research, education, and services for visually impaired patients. Relatively few ophthalmologists practise LVR and fewer still routinely use prismatic image relocation (IR) in AMD patients. IR is a method of stabilizing oculomotor functions with the purpose of promoting better function of preferred retinal loci (PRLs). The aim of vision rehabilitation therapy consists in the achievement of techniques designed to improve PRL usage. The use of PRLs to compensate for diseased foveae has offered hope to these patients in regaining some function. However, in a recently published meta-

analysis, prism spectacles were found to be unlikely to be of substantial benefit in people with age-related macular degeneration. Prescription filters are one of the most beneficial visual aids for people with macular degeneration. In principle, one aims both at reducing short-wavelength light to reduce glare and at identifying light with specific wavelengths (colours) preferred by the patient for viewing. In both instances, such interventions result in apparent improved contrast sensitivity and better visual acuity. Although specific tests are performed to determine the best colour, tint, lens material, and type of frame for the patient's need, no scientific protocol has been developed so far to assist in prescribing tinted or selective transmission lenses. Magnifying optical lenses are available in a wide range of dioptric powers and are made from materials that correct for weight (plastic), thickness (high index), spherical aberrations (aspherical), and variable light intensities (photochromatic). These lenses can be used as loose lenses, mounted on optical frames, or used with a wide variety of attachments. As the dioptric power of plus lenses increases, the viewing distance of the target decreases, hence their usefulness mainly for tasks requiring near resolution acuity, like reading. Magnification can also be achieved with the use of telescopic devices that are built of two or more plus and (or) minus (minifying) optical lenses. Normal resolution acuity levels can be achieved with these devices for all viewing distances. Therefore, all telescopic devices are useful only for stationary patient tasks that do not require mobility and orientation. Electronic magnification has the great advantage over plus lenses of producing an acuity reserve enabling reading skills for almost all levels of visual acuity. The additional benefit provided is preservation of binocularity, even at high levels of visual disparity between the two eyes. Vision rehabilitation can help patients to maximize their remaining vision and adapt to activities of daily living. The support of the patient's social network is critical to patient's wellbeing as patients adjust to being partially sighted. 2010 Bentham Science Publishers Ltd.

Source: EMBASE

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6. fMRI evidence that precision ophthalmic tints reduce cortical hyperactivation in migraine.

Author(s) Huang J, Zong X, Wilkins A, Jenkins B, Bozoki A, Cao Y

Citation: Cephalalgia, June 2011, vol./is. 31/8(925-36), 0333-1024;1468-2982 (2011 Jun)

Publication Date: June 2011

Abstract: BACKGROUND: Certain patterns can induce perceptual illusions/distortions and visual discomfort in most people, headaches in patients with migraine, and seizures in patients with photosensitive epilepsy. Visual stimuli are common triggers for migraine attacks, possibly because of a hyperexcitability of the visual cortex shown in patients with migraine. Precision ophthalmic tints (POTs) are claimed to reduce perceptual distortions and visual discomfort and to prevent migraine headaches in some patients. We report an fMRI visual cortical activation study designed to investigate neurological mechanisms for the beneficial effects of POTs in migraine.METHODS: Eleven migraineurs and 11 age- and sex-matched non-headache controls participated in the study using non-stressful and stressful striped patterns viewed through gray, POT, and control coloured lenses.RESULTS: For all lenses, controls and migraineurs did not differ in their response to the non-stressful patterns. When the migraineurs wore gray lenses or control coloured lenses, the stressful pattern resulted in activation that was greater than in the controls. There was also an absence of the characteristic low-pass spatial frequency (SF) tuning in extrastriate visual areas. When POTs were worn, however, both cortical activation and SF tuning were normalized. Both when observing the stressful pattern and under more typical viewing conditions, the POTs reduced visual discomfort more than either of the other two lenses.CONCLUSION: The normalization of cortical activation and SF tuning in the migraineurs by POTs suggests a neurological basis for the therapeutic effect of these lenses in reducing visual cortical hyperactivation in migraine.

Source: Medline

7. Joint statement -- learning disabilities, dyslexia, and vision.

Author(s)

Citation: Pediatrics, 01 August 2009, vol./is. 124/2(837-844), 00314005

Publication Date: 01 August 2009

Abstract: Learning disabilities, including reading disabilities, are commonly diagnosed in children. Their etiologies are multifactorial, reflecting genetic influences and dysfunction of brain systems. Learning disabilities are complex problems that require complex solutions. Early recognition and referral to qualified educational professionals for evidence-based evaluations and treatments seem necessary to achieve the best possible outcome. Most experts believe that dyslexia is a language-based disorder. Vision problems can interfere with the process of learning; however, vision problems are not the cause of primary dyslexia or learning disabilities. Scientific evidence does not support the efficacy of eye exercises, behavioral vision therapy, or special tinted filters or lenses for improving the long-term educational performance in these complex pediatric neurocognitive conditions. Diagnostic and treatment approaches that lack scientific evidence of efficacy, including eye exercises, behavioral vision therapy, or special tinted filters or lenses, are not endorsed and should not be recommended.

Source: CINAHL

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Available in *fulltext* from *Pediatrics* at *American Academy of Pediatrics*

8. The use of tinted contact lenses in the management of achromatopsia

Author(s) Zeltzer H.I.

Citation: Optometry, July 2007, vol./is. 78/7(328), 1529-1839 (July 2007)

Publication Date: July 2007

Source: EMBASE

9. The use of tinted contact lenses in the management of achromatopsia

Author(s) Schornack M.M., Brown W.L., Siemsen D.W.

Citation: Optometry, January 2007, vol./is. 78/1(17-22), 1529-1839 (January 2007)

Publication Date: January 2007

Abstract: Background: Achromatopsia is a congenital, autosomal recessively inherited condition in which cones are either defective or absent. Complete achromatopsia results from having only rods as functioning photoreceptors. Many people with achromatopsia have small amounts of residual cone function that may provide minimal color vision under special circumstances. Clinical findings associated with the condition include reduced visual acuity, nystagmus, a greater than normal incidence of high ametropia, and severe photophobia. The photophobia resulting from achromatopsia can be debilitating even in normal indoor illumination. Tinted contact lenses have been reported to reduce photophobia and improve visual function in these patients. Cases: Two cases are reported here. A 32-year-old man presented with reduced and stable visual acuity, complete color blindness, nystagmus, and debilitating photophobia. The second patient was a 23-year-old woman who presented with reduced and stable visual acuity, severely impaired color vision, rotary nystagmus, and significant photophobia. Both of these patients were fit with centrally tinted contact lenses. Although visual acuity did not improve measurably in either patient with tinted compared with clear lenses, both experienced a dramatic reduction in photophobia with the lenses. Conclusion: Tinted spectacle or contact lenses may be useful in relieving photophobia associated with a number of cone disorders, including achromatopsia. In addition to decreasing light sensitivity, tinted lenses have been reported to improve visual acuity, decrease the size of central scotomata, enlarge peripheral visual

field, and enhance visibility of long wavelength stimuli in bright illumination. 2007 American Optometric Association.

Source: EMBASE

10. The effect of colored lenses on the visual evoked response in children with visual stress.

Author(s) Riddell PM, Wilkins A, Hainline L

Citation: Optometry & Vision Science, May 2006, vol./is. 83/5(299-305), 1040-5488;1040-5488 (2006 May)

Publication Date: May 2006

Abstract: PURPOSE: Some children with visual stress and/or headaches have fewer symptoms when wearing colored lenses. Although subjective reports of improved perception exist, few objective correlates of these effects have been established.METHODS: In a pilot study, 10 children who wore Intuitive Colorimeter lenses, and claimed benefit, and two asymptomatic children were tested. Steady-state potentials were measured in response to low contrast patterns modulating at a frequency of 12 Hz. Four viewing conditions were compared: 1) no lens; 2) Colorimeter lens; 3) lens of complementary color; and 4) spectrally neutral lens with similar photopic transmission.RESULTS: The asymptomatic children showed little or no difference between the lens and no lens conditions. When all the symptomatic children were tested together, a similar result was found. However, when the symptomatic children were divided into two groups depending on their symptoms, an interaction emerged. Children with visual stress but no headaches showed the largest amplitude visual evoked potential response in the no lens condition, whereas those children whose symptoms included severe headaches or migraine showed the largest amplitude visual evoked potential response when wearing their prescribed lens.CONCLUSIONS: The results suggest that it is possible to measure objective correlates of the beneficial subjective perceptual effects of colored lenses, at least in some children who have a history of migraine or severe headaches.

Source: Medline

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11. The need for optometric investigation in suspected Meares-Irlen syndrome or visual stress

Author(s) Evans B.J.W.

Citation: Ophthalmic and Physiological Optics, July 2005, vol./is. 25/4(363-370), 0275-5408 (July 2005)

Publication Date: July 2005

Abstract: Meares-Irlen syndrome is characterised by symptoms of eye strain, headaches and visual perceptual distortions when viewing text. The symptoms are alleviated with individually prescribed coloured filters, such as precision tinted lenses. Meares-Irlen syndrome, and the related condition of visual stress, are likely to result from hyperexcitability of the visual cortex, which can also occur in migraine. The symptoms of Meares-Irlen syndrome and visual stress are non-specific and the condition needs to be differentially diagnosed from other optometric conditions, such as refractive error, binocular vision anomalies, and accommodative anomalies. Three case reports are described of patients who consulted the author with suspected Meares-Irlen syndrome but were found to have other causes for their symptoms: posterior sub-capsular cataract, high uncorrected astigmatism, and decompensated convergence weakness exophoria. These cases highlight the need for professional eye care for people with suspected Meares-Irlen syndrome. Although this advice is stressed in literature on the well-established MRC/Wilkins Intuitive Colorimeter system, it is not always stressed in literature about other systems. This may be a cause for concern. 2005 The College of Optometrists.

Source: EMBASE

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12. Increasing reading speed by using colours: issues concerning reliability and specificity, and their theoretical and practical implications.

Author(s) Wilkins AJ, Sihra N, Myers A

Citation: Perception, 2005, vol./is. 34/1(109-20), 0301-0066;0301-0066 (2005)

Publication Date: 2005

Abstract: By using techniques for precision ophthalmic tinting, individuals who report perceptual distortion of text can often find a colour of illumination that eliminates the distortions and increases reading speed. Most individuals choose green or blue hues, but there is considerable variability. We investigated how specific the colour has to be to obtain optimal reading speed. Individuals who habitually wear coloured filters for reading were asked to read text illuminated by coloured light (without using their filters). Reading speed was measured repeatedly with light of different colours. The colour (chromaticity) at which reading was fastest was consistent from one test session to the next. It was different from one individual to another, but highly specific for each individual: departures of colour from optimum by about 6 JNDs eliminated most of the speed advantage conferred by the optimal colour. It was difficult to attribute the consistency and specificity simply to familiarity with the tint or immediate memory for the colour of illumination. A consecutive sample of 1000 tint prescriptions was analysed numerically. For most prescriptions the variation in chromaticity with different types of lighting was not such as to remove all the potential benefit of the tint, as judged from a model of the effect of chromaticity on reading speed. The exceptions were the few tints that were weakly saturated or purple in colour. Across participants, reading speed was not consistently related to the scotopic energy, to the energy captured by any cone class, or to opponent colour processes. The reading was generally slowest with white light, and not with the colour complementary to the optimum. Explanations in terms of magnocellular deficits and cortical hyperexcitability are briefly discussed.

Source: Medline

13. The effect of coloured filters on the rate of reading in an adult student population.

Author(s) Evans BJ, Joseph F

Citation: Ophthalmic & Physiological Optics, November 2002, vol./is. 22/6(535-45), 0275-5408;0275-5408 (2002 Nov)

Publication Date: November 2002

Abstract: Meares-Irlen Syndrome is characterised by visual stress (visual discomfort) and visual perceptual distortions that can be alleviated by individually prescribed coloured filters. The benefit from coloured filters can be demonstrated with the Wilkins Rate of Reading Test (WRRT). Previous research using individually prescribed coloured overlays (sheets of plastic placed on a page) found that between one-fifth and one-third of unselected school-children show a significant (> 5%) improvement in their rate of reading with their chosen overlay. This 5% cut-off has good sensitivity and specificity for predicting those children who will continue to voluntarily use their overlay for a sustained period. Previous research has concentrated on children, and we sought to investigate the immediate effect of overlays on rate of reading in an adult population. Subjects were 113 unselected university students who answered a symptom questionnaire and were tested with the Wilkins Intuitive Overlays and WRRT. Some symptoms were common: 73% reported sore or tired eyes when reading and 40% reported four to 12 headaches a year. One hundred of the subjects chose an overlay as improving their immediate perception of text. These subjects were significantly more likely to report perceptual distortions and visual discomfort on viewing text than subjects who did not choose an overlay. The 100 subjects read 3.8% faster with the overlay than without any overlay ($p < 0.00001$), whereas the 13 subjects who did not choose an overlay read 1.7% slower with a placebo overlay than without ($p = 0.37$). Of the subjects who chose an overlay, 38% read more than 5% faster with the overlay and 2% read more than 25% faster. These results are comparable with those obtained for children. We conclude that Meares-Irlen Syndrome is likely to be as

common in adults as it is in children.

Source: Medline

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14. Optometric function in visually sensitive migraine before and after treatment with tinted spectacles.

Author(s) Evans BJ, Patel R, Wilkins AJ

Citation: Ophthalmic & Physiological Optics, March 2002, vol./is. 22/2(130-42), 0275-5408;0275-5408 (2002 Mar)

Publication Date: March 2002

Abstract: Optometrists frequently encounter patients with migraine and patients and practitioners sometimes suspect that visual stimuli or visual anomalies trigger headaches. There is a lack of evidence-based research on the issue, however. Some patients with migraine may be hypersensitive to visual stimuli, and it has been suggested that individually prescribed coloured filters might be an effective treatment to reduce symptoms from such stimuli. A recent randomised controlled trial showed such a treatment to be effective and the present paper reports on the optometric characteristics of the patients in this study. Twenty-one patients with neurologically diagnosed migraine were compared with 11 controls. No significant differences were found between the two groups with respect to refractive error, ocular pathology, colour vision, contrast sensitivity, accommodative function, strabismus and hyperphoria. The migraine group tended to be a little more exophoric, but by most criteria they were able to compensate for their exophoria as well as the control group. The migraine group were more prone to pattern glare than the controls ($p = 0.004$). The effects of precision tinted and control tinted lenses were investigated. The only variable to show a consistent and marked improvement with tinted lenses was pattern glare. The most likely mechanism for the benefit from individually prescribed coloured filters in migraine is the alleviation of cortical hyperexcitability (Wilkins et al. 1994) and associated pattern glare.

Source: Medline

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Available in *fulltext* from *Ophthalmic & Physiological Optics* at *EBSCOhost*

15. Optometric function in visually sensitive migraine before and after treatment with tinted spectacles

Author(s) Evans B.J.W., Patel R., Wilkins A.J.

Citation: Ophthalmic and Physiological Optics, March 2002, vol./is. 22/2(130-142), 0275-5408 (March 2002)

Publication Date: March 2002

Abstract: Optometrists frequently encounter patients with migraine and patients and practitioners sometimes suspect that visual stimuli or visual anomalies trigger headaches. There is a lack of evidence-based research on the issue, however. Some patients with migraine may be hypersensitive to visual stimuli, and it has been suggested that individually prescribed coloured filters might be an effective treatment to reduce symptoms from such stimuli. A recent randomised controlled trial showed such a treatment to be effective and the present paper reports on the optometric characteristics of the patients in this study. Twenty-one patients with neurologically diagnosed migraine were compared with 11 controls. No significant differences were found between the two groups with respect to refractive error, ocular pathology, colour vision, contrast sensitivity, accommodative function, strabismus and hyperphoria. The migraine group tended to be a little more exophoric, but by most criteria they were able to compensate for their exophoria as well as the control group. The migraine group were more prone to pattern glare than the controls ($p=0.004$). The effects of precision tinted and control tinted lenses were investigated. The only variable to show a consistent and marked improvement with tinted lenses was pattern

glare. The most likely mechanism for the benefit from individually prescribed coloured filters in migraine is the alleviation of cortical hyperexcitability (Wilkins et al. 1994) and associated pattern glare. 2002 The College of Optometrists.

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16. Do tinted lenses or filters improve visual performance in low vision? A review of the literature.

Author(s) Eperjesi F, Fowler CW, Evans BJ

Citation: Ophthalmic & Physiological Optics, January 2002, vol./is. 22/1(68-77), 0275-5408;0275-5408 (2002 Jan)

Publication Date: January 2002

Abstract: This is a review of studies that have investigated the proposed rehabilitative benefit of tinted lenses and filters for people with low vision. Currently, eye care practitioners have to rely on marketing literature and anecdotal reports from users when making recommendations for tinted lens or filter use in low vision. Our main aim was to locate a prescribing protocol that was scientifically based and could assist low vision specialists with tinted lens prescribing decisions. We also wanted to determine if previous work had found any tinted lens/task or tinted lens/ocular condition relationships, i.e. were certain tints or filters of use for specific tasks or for specific eye conditions. Another aim was to provide a review of previous research in order to stimulate new work using modern experimental designs. Past studies of tinted lenses and low vision have assessed effects on visual acuity (VA), grating acuity, contrast sensitivity (CS), visual field, adaptation time, glare, photophobia and TV viewing. Objective and subjective outcome measures have been used. However, very little objective evidence has been provided to support anecdotal reports of improvements in visual performance. Many studies are flawed in that they lack controls for investigator bias, and placebo, learning and fatigue effects. Therefore, the use of tinted lenses in low vision remains controversial and eye care practitioners will have to continue to rely on anecdotal evidence to assist them in their prescribing decisions. Suggestions for future research, avoiding some of these experimental shortcomings, are made.

Source: Medline

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17. Randomised controlled trial of the effect of coloured overlays on the rate of reading of people with specific learning difficulties.

Author(s) Bouldoukian J, Wilkins AJ, Evans BJ

Citation: Ophthalmic & Physiological Optics, January 2002, vol./is. 22/1(55-60), 0275-5408;0275-5408 (2002 Jan)

Publication Date: January 2002

Abstract: A randomised controlled trial has demonstrated that, for selected children with reading difficulties, individually prescribed coloured filters reduce symptoms of asthenopia. In the present study, we investigate the effect of individually prescribed coloured overlays on the rate of reading. Subjects were 33 children and adults who: had consulted a specific learning difficulties clinic; had received treatment to normalise any conventional optometric and orthoptic anomalies; and subsequently reported symptomatic relief from coloured filters. These subjects carried out the Wilkins Rate of Reading Test (which assesses visual rather than linguistic factors) under two conditions: with their chosen coloured overlay and with a control filter. Steps were taken to ensure that a strong placebo effect was associated with the control overlay and, when asked which they preferred, subjects were not significantly more likely to prefer their coloured overlay than the control filter (p=0.11). Nonetheless, the rate of reading was significantly faster with the coloured overlay than with

the control (p=0.0019). Further analyses support the conclusion that individually prescribed coloured filters can improve reading performance for reasons that cannot be solely attributed to conventional optometric factors or to placebo effects.

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Available in *fulltext* from *Ophthalmic & Physiological Optics* at *EBSCOhost*

18. The influence of tinted lenses upon ocular accommodation.

Author(s) Simmers AJ, Gray LS, Wilkins AJ

Citation: Vision Research, April 2001, vol./is. 41/9(1229-38), 0042-6989;0042-6989 (2001 Apr)

Publication Date: April 2001

Abstract: We determined the effect upon accommodative responses of tinted lenses prescribed for the relief of visual discomfort in a group of five long term lens wearers. Static and dynamic responses were measured under four viewing conditions (1) prescribed tinted lens (2) neutral density filter (3) tinted lens of complementary colour and (4) no absorptive lens. While similarity and normality of the mean stimulus-response functions between the four viewing conditions were evident, the low frequency component of the accommodation microfluctuations was significantly greater while viewing the target in the 'no lens' viewing condition. These increases in the low frequency components (LFC) of the accommodation may be a subtle indicator of visual stress in these patients. Colour specificity is not supported by this finding.

Source: Medline

19. The ChromaGen contact lens system: Colour vision test results and subjective responses

Author(s) Swarbrick H.A., Nguyen P., Nguyen T., Pham P.

Citation: Ophthalmic and Physiological Optics, 2001, vol./is. 21/3(182-196), 0275-5408 (2001)

Publication Date: 2001

Abstract: The ChromaGen lens system is designed to enhance colour perception in colour vision deficiency (CVD). To investigate its efficacy, 14 CVD subjects were prescribed ChromaGen contact lenses. Colour vision tests (Ishihara, Farnsworth Munsell D-15, Farnsworth Lantern) were administered at baseline, lens dispensing, and after a 2-week lens-wearing trial during which subjective responses were recorded daily using visual analogue scales. ChromaGen lenses significantly reduced Ishihara error rates ($p<0.001$; ANOVA), particularly for deutan subjects. There was also a significant reduction in errors ($p<0.005$) on the D-15 test. Conversely, lens wear had no significant effect on Farnsworth Lantern test performance. Subjectively, subjects reported enhanced colour perception, but poor vision in dim light. Judgement of distance and motion were only slightly affected. We conclude that ChromaGen lenses may enhance subjective colour experience and assist in certain colour-related tasks, but are not indicated as an aid for CVD in occupations with colour vision-related restrictions. Copyright 2001 The College of Optometrists.

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20. Treatment of photosensitive epilepsy using coloured glasses.

Author(s) Wilkins AJ, Baker A, Amin D, Smith S, Bradford J, Zaiwalla Z, Besag FM, Binnie CD, Fish D

Citation: Seizure, December 1999, vol./is. 8/8(444-9), 1059-1311;1059-1311 (1999 Dec)

Publication Date: December 1999

Abstract: A recently introduced optometric technique, colorimetry, enables the perceptual effects of ophthalmic tints to be evaluated subjectively, optimized, and then prescribed in tinted spectacles. The new technique is beneficial in reducing visual stress in patients with dyslexia and migraine. We describe an open trial designed to ascertain: (1) whether the colorimetry assessment, as it is now given, is safe for the investigation of photosensitive patients in optometry clinics where colorimetry equipment is most readily available, but where EEG control is not practical; (2) what proportion of patients with photosensitive epilepsy is likely to benefit to the extent already described in individual cases; (3) whether a tint selected by colorimetry could be shown to reduce the incidence of paroxysmal epileptiform EEG activity in response to flicker and patterns, thereby validating the subjective methods and corroborating the reported seizure reduction. Twenty-four females and nine males (aged 12-43 years) took part. All the patients had suffered visually-provoked seizures, had exhibited a photoparoxysmal response on at least one previous EEG recording, and had received a diagnosis of photosensitive epilepsy. Twenty-two were currently experiencing seizures. A further EEG was recorded in all except seven cases: a routine resting record, followed by hyperventilation. Colorimetry was performed after hyperventilation and before photic stimulation. Twenty-three (70%) reported beneficial effects during colorimetry and were prescribed glasses. There was a preponderance of lenses with a rose or purple colour, in contrast to patients with dyslexia. Seventeen of the 23 patients were available at follow-up, an average of 2.4 years later. Thirteen (57%) reported benefits, and said they were still using the lenses. In six of the 13 the benefits were pronounced, including a reduction of dizziness from fluorescent lighting, elimination of aura when using computer screens etc. Only in three cases was there a reduction in seizures that could reasonably be attributed to the use of lenses; in two of these cases no medications were prescribed, and in the third the medications remained unchanged for four years, two before and two after the introduction of the glasses. In an additional four cases a reduction in seizures was observed but medication had been changed. There was a modest reduction in EEG photosensitivity with the coloured lenses but also to an equivalent or lesser extent with grey in all of the eight patients examined in this way. One patient had seizures during colorimetry, but the seizures were not accompanied by scalp EEG changes.

Source: Medline

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21. A review of the management of 323 consecutive patients seen in a specific learning difficulties clinic

Author(s) Evans B.J.W., Patel R., Wilkins A.J., Lightstone A., Eperjesi F., Speedwell L., Duffy J.

Citation: Ophthalmic and Physiological Optics, November 1999, vol./is. 19/6(454-466), 0275-5408 (November 1999)

Publication Date: November 1999

Abstract: Visual correlates of specific learning difficulties (SpLD) include: binocular instability, low amplitude of accommodation, and Meares-Irlen Syndrome. Meares-Irlen Syndrome describes asthenopia and perceptual distortions which are alleviated by using individually prescribed coloured filters. Data from 323 consecutive patients seen over a 15 month period in an optometric clinic specialising in SpLD are reviewed. Visual symptoms and headaches were common. 48% of patients were given a conventional optometric intervention (spectacles, orthoptic exercises) and 50% were issued with coloured filters, usually for a trial period. 40% of those who were given orthoptic exercises were later issued with coloured overlays. 32% of those who were issued with coloured overlays were ultimately prescribed Precision Tinted lenses. Approximately half the sample were telephoned more than a year after the last clinical appointment. More than 70% of those who were prescribed Precision Tints were still wearing them daily, and results for this intervention compared favourably with data for non-tinted spectacles. The data suggest that many people with SpLD need optometric care and that the optometrist needs to be skilled in orthoptic techniques and cognisant of recent research on coloured filters.

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22. A preliminary investigation into the aetiology of Meares-Irlen syndrome.

Author(s) Evans BJ, Wilkins AJ, Brown J, Busby A, Wingfield A, Jeanes R, Bald J

Citation: Ophthalmic & Physiological Optics, July 1996, vol./is. 16/4(286-96), 0275-5408;0275-5408 (1996 Jul)

Publication Date: July 1996

Abstract: A recent double-masked placebo-controlled trial has confirmed that some children experience a reduction in symptoms of eyestrain and headache when they read through individually prescribed coloured filters and has shown that this benefit cannot be solely attributed to a placebo effect. People who are helped by coloured filters in this way have been described as having "Meares-Irlen syndrome'. We investigated the mechanism of this benefit by studying the optometric and visual perceptual characteristics of the children in the double-masked study. This population had normal refractive errors and heterophorias (none of the subjects had strabismus). They demonstrated slightly, but significantly, reduced amplitudes of accommodation and vergence and poor stereo-acuity. However, these factors seemed to be correlates of Meares-Irlen syndrome rather than the underlying cause. Pattern glare, a sensitivity to striped patterns (e.g. lines of text), was prevalent in our sample and was significantly associated with the subjects' symptoms. The spatial contrast sensitivity function was normal.

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Available in *fulltext* from *Ophthalmic & Physiological Optics* at *EBSCOhost*

23. A new protocol for the optometric management of patients with reading difficulties.

Author(s) Lightstone A, Evans BJ

Citation: Ophthalmic & Physiological Optics, September 1995, vol./is. 15/5(507-12), 0275-5408;0275-5408 (1995 Sep)

Publication Date: September 1995

Abstract: Research by Evans et al. (Ophthal. Physiol. Opt. 15, 481-487, 1995) has demonstrated a correlation between visual processing and ocular motor factors in people with specific reading difficulties (dyslexia). In addition, research by Wilkins et al. (Ophthal. Physiol. Opt. 14, 365-370, 1994) has shown that some people with dyslexia will benefit from a reduction of perceptual symptoms of discomfort and distortion if they use individually prescribed coloured filters. Three examples of the dyslexic patients who attend at the Institute of Optometry clearly demonstrate the importance of full investigation of ocular function, including the assessment of the effect of colour on visual perception. All three patients presented with similar symptoms of asthenopia when reading. Symptoms were alleviated for the first patient by use of orthoptic treatment of an exotropia with intermittent suppression. With the second patient, ocular motor functions were found to be within acceptable limits and relief of symptoms was obtained by the prescribing of lenses of a specific chromaticity. For the third patient, both orthoptic intervention and the use of specifically tinted lenses were necessary to relieve the visual difficulties that were being experienced. By taking advantage of recent research and developments in optometric instrumentation, it is possible for some of those with dyslexia to receive considerable benefit from optometric intervention.

Source: Medline

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24. Double-masked placebo-controlled trial of precision spectral filters in children who use coloured overlays.

Author(s) Wilkins AJ, Evans BJ, Brown JA, Busby AE, Wingfield AE, Jeanes RJ, Bald J

Citation: Ophthalmic & Physiological Optics, October 1994, vol./is. 14/4(365-70), 0275-5408;0275-5408 (1994 Oct)

Publication Date: October 1994

Abstract: We selected 68 children who reported benefit from individually chosen sheets of coloured plastic placed upon the page when reading, and who used these regularly without prompting. These children viewed text illuminated by coloured light in an apparatus that allowed the separate manipulation of hue (colour) and saturation (depth of colour), at constant luminance. Many of the children reported improvements in perception when the light had a chromaticity within a limited range, which was different for each individual. A pair of plastic spectacle lenses ('experimental' lenses) was dyed so as to provide the appropriate chromaticity under conventional white (F3) fluorescent light. An additional pair was prepared having very similar colour but with a chromaticity outside the range in which perception was reported to improve ('control' lenses). Each pair was provided for 1 month in random order. The children kept diaries (36 completed) recording symptoms of eye-strain and headache. The children and those responsible for their assessment were unable reliably to distinguish 'experimental' from 'control' lenses. Nevertheless, symptoms were less frequent on days when the 'experimental' lenses were worn ($P < 0.003$).

Source: Medline

Available in *fulltext* from *Ophthalmic & Physiological Optics* at *EBSCOhost*

25. Tinted lenses and related therapies for learning disabilities--a review.

Author(s) Evans BJ, Drasdo N

Citation: Ophthalmic & Physiological Optics, July 1991, vol./is. 11/3(206-17), 0275-5408;0275-5408 (1991 Jul)

Publication Date: July 1991

Abstract: Research relating to the use of Irlen tinted lenses and coloured overlays for underachievers is reviewed. Many of the studies were not published in refereed journals and were methodologically poor. The weaknesses of the Irlen argument are discussed, including the absence of evidence to support the claims that these tints need to be uniquely prescribed and manufactured. Syntonics is another form of visual colour therapy that has been applied to those with a learning disability. Research on this is reviewed, and is also shown to have procedural irregularities which preclude firm conclusions. Owing to the poor quality of much of this research the claims of the protagonists of these therapies cannot be proved or disproved. A proposed new therapy is normally preceded by a valid theoretical hypothesis; this has been lacking in the present topic. Recently, a feasible explanation has been proposed in terms of 'pattern glare' resulting from mild hypersensitivity to epileptogenic patterns. This, together with potential alternative theories, is discussed. In the conclusion of this review, advice is given for eye-care practitioners who may be consulted on these therapies.

Source: Medline

Available in *fulltext* from *Ophthalmic & Physiological Optics* at *EBSCOhost*

26. Color-mediated contrast sensitivity in disabled readers.

Author(s) Solman RT, Dain SJ, Keech SL

Citation: Optometry & Vision Science, May 1991, vol./is. 68/5(331-7), 1040-5488;1040-5488 (1991 May)

Publication Date: May 1991

Abstract: Specific deficits in the processing of transient visual stimuli have been identified in reading-disabled children. It has been suggested that suitably chosen colored filters can assist reading-disabled children but this is controversial. In order to assess how colored lenses might assist a reading-disabled child, we compared contrast sensitivity judgments of 20 disabled readers with those made by 20 good readers of the same age. Contrast sensitivity thresholds were measured over a spatial frequency range of 0.4 to 12.8 cpd. Contrast sensitivity functions were recorded for each child under four different conditions. For each condition the child wore a spectacle frame with a colored filter which had been selected on the basis of the child's best and worst performances on a spatial location task (BEST and WORST), a neutral density optical filter (GRAY), and an untinted filter (CLEAR). The results showed that the best colored filter selected for each of the disabled readers dramatically reduced sensitivity as the spatial frequency moved into the range of printed material (i.e., sensitivity declined sharply from 0.4 to 12.8 cpd). In contrast, there was very little change in sensitivity for the good readers using their best filters. These provocative findings suggest that colored optical filters might improve transient-on-sustained inhibition in disabled readers. It is possible that individually designed filters will provide a way of mitigating the effects of weak transient processing in reading-disabled children. However, our results should not be interpreted as supporting the efficacy of prescribed, colored optical filters as a remediation technique for reading disability.

Source: Medline

Available in *fulltext* from *Optometry and Vision Science* at *Free Access Content*

27. Reading disabilities and the effects of colored filters.

Author(s) O'Connor PD, Sofo F, Kendall L, Olsen G

Citation: Journal of Learning Disabilities, December 1990, vol./is. 23/10(597-603, 620), 0022-2194;0022-2194 (1990 Dec)

Publication Date: December 1990

Abstract: The efficacy of a controversial treatment, using colored filters to remediate reading disabilities, was measured empirically, with colored overlays placed over reading material on white paper. Irlen's (1983) method is to prescribe specific tinted filters as lenses that she claims filter specific light frequencies and remove a range of perceptual disorders that adversely affect reading and related learning performance. Irlen calls this condition "scotopic sensitivity" and claims it is a significant factor in a high percentage of people with learning disabilities. Ninety-two children with significant reading disabilities were classified as either scotopic or nonscotopic using the Irlen Differential Perceptual Schedule, and were randomly assigned to one of six treatment groups using colored or clear overlays. Reading performance (rate, accuracy, and comprehension) as measured by the Neale Analysis of Reading Ability (Neale, 1987) and the Formal Reading Inventory (Wiederholt, 1986) improved significantly when the scotopic children read with the preferred colored overlay filter compared to clear or different-colored overlay filters. Nonscotopic children showed no change.

Source: Medline

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Available in *fulltext* from *Journal of Learning Disabilities* at *EBSCOhost*

28. A review of the use of Irlen (tinted) lenses.

Author(s) Cotton MM, Evans KM

Citation: Australian & New Zealand Journal of Ophthalmology, August 1990, vol./is. 18/3(307-12), 0814-9763;0814-9763 (1990 Aug)

Publication Date: August 1990

Abstract: Helen Irlen identified a syndrome defined as 'scotopic sensitivity' which it was claimed could be responsible for the inability of some people to read fluently and the symptoms of which could be ameliorated by the wearing of prescribed coloured lenses. The literature to date presents a confused and inconsistent picture concerning the use of the

lenses. The literature (much of which is unpublished and difficult to obtain) is critically reviewed. Recent experimental evaluations of the lenses do not support the use of the lenses as a useful intervention for children with reading disabilities.

Source: Medline

29. Effect of X-Chrom lens wear on chromatic discrimination and stereopsis in color-deficient observers

Author(s) Matsumoto E.R., Johnson C.A., Post R.B.

Citation: American Journal of Optometry and Physiological Optics, 1983, vol./is. 60/4(297-302), 0093-7002 (1983)

Publication Date: 1983

Abstract: Four color-deficient observers and one normal trichromatic subject were evaluated with color vision and stereoacuity tests during 1 month of X-Chrom lens wear. For all color tests, performance of the normal subject was unaltered by X-Chrom lens wear. Color-deficient subjects demonstrated improved performance on the Ishihara pseudoisochromatic color plates, but either degraded performance or no change on the Farnsworth-Munsell 100-hue or Pickford-Nicolson red-green anomaloscope test. Three of the five subjects exhibited degraded stereoacuity in conjunction with X-Chrom lens wear. We conclude that the X-Chrom lens does not improve discrimination in color-deficient subjects and may alter stereopsis.

Source: EMBASE

30. The X-Chrom lens for correction of color deficiency

Author(s) Paulson H.M.

Citation: Military Medicine, 1980, vol./is. 145/8(557-560), 0026-4075 (1980)

Publication Date: 1980

Abstract: The effectiveness of the X-Chrom lens in alleviating the defective color vision of two men (a severe protanomalous trichromat and a dichromatic deuteranope) was evaluated with an extensive battery of color vision tests. The first man failed all tests except one without and with the X-Chrom lens: The second failed all tests without the lens; with the lens, he passed three tests but performed significantly poorer on two other tests. It is emphasized that color vision tests are designed to be used only under standard illumination, and that passing such tests under non-standard conditions does not signify normal color vision. These results provide no evidence that the X-Chrom lens corrects color deficiency.

Source: EMBASE

Initial search

1. A new spectrally sharpened sensor basis to predict color naming, unique hues, and hue cancellation

Author(s) Vazquez-Corral J., O'Regan J.K., Vanrell M., Finlayson G.D.

Citation: Journal of vision, 2012, vol./is. 12/6(7), 1534-7362 (2012)

Publication Date: 2012

Abstract: When light is reflected off a surface, there is a linear relation between the three human photoreceptor responses to the incoming light and the three photoreceptor responses to the reflected light. Different colored surfaces have different linear relations. Recently, Philipona and O'Regan (2006) showed that when this relation is singular in a mathematical sense, then the surface is perceived as having a highly nameable color. Furthermore, white light reflected by that surface is perceived as corresponding precisely to one of the four psychophysically measured unique hues. However, Philipona and O'Regan's approach seems unrelated to classical psychophysical models of color constancy. In this paper we make this link. We begin by transforming cone sensors to

spectrally sharpened counterparts. In sharp color space, illumination change can be modeled by simple von Kries type scalings of response values within each of the spectrally sharpened response channels. In this space, Philipona and O'Regan's linear relation is captured by a simple Land-type color designator defined by dividing reflected light by incident light. This link between Philipona and O'Regan's theory and Land's notion of color designator gives the model biological plausibility. We then show that Philipona and O'Regan's singular surfaces are surfaces which are very close to activating only one or only two of such newly defined spectrally sharpened sensors, instead of the usual three. Closeness to zero is quantified in a new simplified measure of singularity which is also shown to relate to the chromaticness of colors. As in Philipona and O'Regan's original work, our new theory accounts for a large variety of psychophysical color data.

Source: EMBASE

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2. Aftereffect of contrast adaptation to a chromatic notched-noise stimulus

Author(s) Kuriki I.

Citation: Journal of the Optical Society of America. A, Optics, image science, and vision, July 2007, vol./is. 24/7(1858-1872), 1084-7529 (Jul 2007)

Publication Date: July 2007

Abstract: One of the most challenging topics in the study of human color vision is the investigation of the number of hue-selective channels that are necessary for the representation of color appearance at the post-opponent level and the bandwidth of their sensitivity. The present study aims to elucidate this issue by using a chromatic version of the notch-filtered noise (herein, notched-noise) stimulus for contrast adaptation. After adaptation to this stimulus, some color-sensitive mechanisms that selectively respond to missing hues in the notched-noise stimulus may remain sensitive, while the other mechanisms may be desensitized. The shifts in the color appearance of a gray test field after the adaptation to such a notched noise were measured using the method of adjustment. The results showed systematic shifts in the hue and saturation. They showed neither point nor line symmetric profiles with respect to the achromatic point in an isoluminant plane. The fittings of the results, obtained by using a tiny numerical model for assessing the hue-selective mechanisms, suggested that there are at least two narrowly tuned and at least three broadly tuned mechanisms. The narrowly tuned mechanisms are the most sensitive along the blue and yellow directions. The present study confirmed the variation of multiple channels at the post-opponent level and suggested that this variation may be responsible for the processing of color appearance.

Source: EMBASE

3. Brightness sensitivity and color perception as predictors of relative afferent pupillary defect

Author(s) Danesh-Meyer H.V., Papchenko T.L., Savino P.J., Gamble G.D.

Citation: Investigative Ophthalmology and Visual Science, August 2007, vol./is. 48/8(3616-3621), 0146-0404 (August 2007)

Publication Date: August 2007

Abstract: PURPOSE. To characterize the relationship between brightness sensitivity and color perception and relative afferent pupillary defect (RAPD) in patients with optic neuropathy. METHODS. The "swinging flashlight testwas used to diagnose RAPD, the degree of which was quantified by neutral density filters, in 325 consecutive patients in a case-control study. A separate examiner, masked to the pupillary findings, then assessed participants for Ishihara color plate reading, brightness sense, and red perception. The latter two were quantified by asking the patient to score (out of 100%) brightness (of a light source) or redness (of an object) of the two eyes relative to each other. Pearson correlation

coefficients and receiver operating characteristic (ROC) curves were calculated. RESULTS. Brightness sense (r = - 0.79; 95% confidence interval [CI], -0.84 to -0.73; P < 0.0001), red perception (r = -0.73; 95% CI, -0.79 to -0.65; P < 0.0001), and Ishihara color plate reading (r = -0.68; 95% CT, -0.79 to -0.66; P < 0.0001) were each strongly and highly significantly correlated with the diagnosis and degree of RAPD. Brightness sense and red perception were each able to discriminate almost all the area under ROC for the diagnosis of RAPD (area of 0.99; 95% CI, 0.98 -1.00; P < 0.0001; area of 0.93; 95% CI, 0.90-0.96; P < 0.0001, respectively). Sensitivity and specificity of brightness sense in detection of RAPD were 99% (95% CI, 0.97-1.00) and 95% (95% CI, 0.91-0.98), respectively. The red perception test was only slightly less accurate. CONCLUSIONS. Rapid, simple assessments of brightness sense and color perception provide accurate methods to facilitate the diagnosis of optic neuropathy and may prove to be valuable in screening for optic neuropathy or alternatives to the swinging flashlight test. Copyright Association for Research in Vision and Ophthalmology.

Source: EMBASE

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Available in *fulltext* from *Investigative Ophthalmology and Visual Science* at ***Highwire Press***

4. Clinical examination of the chromatic saturation

Author(s) Lanthony P.

Citation: Neuro-Ophthalmology, 1990, vol./is. 10/3(119-127), 0165-8107 (1990)

Publication Date: 1990

Abstract: The attribute of color vision known as 'saturation' was studied in the diagnosis of congenital and acquired dyschomatopsias, by means of tests elaborated from the Munsell Book of Color. The results were as follows: The desaturated Panel D-15 evidenced the color confusions occurring during dyschromatopsias, at a low level of saturation (Munsell chroma 2), thus allowing early diagnosis of neural and retinal diseases; on account of the test's great sensitivity, it is obligatory that the norms be assessed in relation to the subject's age. The 'New Color Test', in the separation phase, directly evidenced the neutral zone of the dyschromatopsias, thus indicating the axis of the color deficiencies. The New Color Test, in the color classification phase, evaluated the severity of color deficiencies according to the level of saturation. The New Color Test, in the grey classification phase, may give indications as to the luminous relative efficiency curve and lightness discrimination. Some experiments (not yet commercially available) also gave promising results for the evaluation of saturation in daily clinical practice.

Source: EMBASE

5. CMOS tunable-wavelength multi-color photogate sensor

Author(s) Ho D., Noor M.O., Krull U.J., Gulak G., Genov R.

Citation: IEEE transactions on biomedical circuits and systems, December 2013, vol./is. 7/6(805-819), 1940-9990 (Dec 2013)

Publication Date: December 2013

Abstract: A CMOS tunable-wavelength multi-color photogate (CPG) sensor is presented. Sensing of a small set of well-separated wavelengths (e.g., > 50 nm apart) is achieved by tuning the spectral response of the device with a bias voltage. The CPG employs the polysilicon gate as an optical filter, which eliminates the need for an external color filter. A prototype has been fabricated in a standard 0.35 mum digital CMOS technology and demonstrates intensity measurements of blue (450 nm), green (520 nm), and red (620 nm) illumination with peak signal-to-noise ratios (SNRs) of 34.7 dB , 29.2 dB, and 34.8 dB, respectively. The prototype is applied to fluorescence detection of green-emitting quantum dots (gQDs) and red-emitting quantum dots (rQDs). It spectrally differentiates among multiple emission bands, effectively implementing on-chip emission filtering. The prototype demonstrates single-color measurements of gQD and rQD concentrations to a detection

limit of 24 nM, and multi-color measurements of solutions containing both colors of QDs to a detection limit of 90 nM and 120 nM of gQD and rQD, respectively.

Source: EMBASE

6. Direct estimation of multidimensional perceptual distributions: Assessing hue and form

Author(s) Cohen D.J.

Citation: Perception and Psychophysics, October 2003, vol./is. 65/7(1145-1160), 0031-5117 (October 2003)

Publication Date: October 2003

Abstract: The procedures developed to assess the perceptual and decisional processes associated with detection in multidimensional space all require specialized statistical skills and analysis programs. The present article describes a regression model, designed to assess dimensional interactions, that is both computationally simpler and more accessible than those procedures. The paper validates the regression model by comparing the perceptual space associated with the detection of hue and form mapped by the regression model with that mapped by Kadlec and Townsend's (1992a, 1992b) macro- and microanalyses. The results of both analyses showed that hue strongly influences the perception of form but that form only weakly influences the perception of hue. The parallel results of the two analyses suggest that the regression model is a valid alternative to multidimensional signal detection theory analysis.

Source: EMBASE

7. Discriminating colors through a red filter by protanopes and colour normals

Author(s) Diaconu V., Sullivan D., Bouchard J.F., Vucea V.

Citation: Ophthalmic and Physiological Optics, January 2010, vol./is. 30/1(66-75), 0275-5408;1475-1313 (January 2010)

Publication Date: January 2010

Abstract: Individuals with color vision deficiency have difficulties in differentiating colour in their daily activities. Through certain coloured filters, dichromats may report an improvement of their capacity to differentiate colors, but it is not known if this is achieved by means of a chromatic mechanism. The present study attempts to explain the mechanism by which a coloured filter can produce a beneficial effect in dichromatic visual perception and what is the nature of this improvement. Four male protanopes and four normal trichromats (two males and two females) participated in the present study. We evaluated the effect of the red filter (with a spectral transmittance similar to that of the X-Chrom filter) on the detection thresholds for monochromatic light stimuli from 420 to 660 nm in 20 nm steps. The increment spectral sensitivity functions were measured for 1.2degree diameter test flashes presented for 300 ms on a 60-cd m⁻² illuminant C background using an optical bench with a monochromator, for both filter and no filter conditions. The capacity to correctly name green, yellow and red for the monochromatic lights of 550, 575 and 625 nm presented for 300 ms on a 60 cd m⁻² illuminant C background screen was also evaluated with and without the red filter. The spectral sensitivity data suggest that, the use of a red filter improves the protanope's capacity to detect long wavelength light stimuli. The results on the colors naming procedure demonstrate that the red filter modifies colour perception in normal and protanope subjects. In normals, only the red color perception is preserved, and typical colour perception for the green and the yellow is lost. Without the filter, all the protanopes demonstrated a residual colour perception for red and green colours. Through the red filter only red colour perception remains. A red filter does not improve the protanopic red-green perception, but it does improve the ability of the protanope to detect long-wavelength light. This improvement seems to arise by means of the luminance mechanism. 2010 The College of Optometrists.

Source: EMBASE

Available in *fulltext* from *Ophthalmic & Physiological Optics* at ***EBSCOhost***

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8. Effects of wearing yellow spectacles on visual skills, reading speed, and visual symptoms in children with reading difficulties

Author(s) Palomo-Alvarez C., Puell M.C.

Citation: Graefe's Archive for Clinical and Experimental Ophthalmology, March 2013, vol./is. 251/3(945-951), 0721-832X;1435-702X (March 2013)

Publication Date: March 2013

Abstract: Background: Possible beneficial effects of yellow-tinted spectacle lenses on binocular vision, accommodation, oculomotor scanning, reading speed and visual symptoms were assessed in children with reading difficulties. Methods: A longitudinal prospective study was performed in 82 non-dyslexic children with reading difficulties in grades 3-6 (aged 9-11 years) from 11 elementary schools in Madrid (Spain). The children were randomly assigned to two groups: a treatment (n = 46) and a without-treatment group (n = 36). Children in the treatment group wore yellow spectacle lenses with best correction if necessary over 3 months (in school and at home). The tests were first undertaken without the yellow filter. With best spectacle correction in each subject, measurements were made of: distance and near horizontal heterophoria, distance and near horizontal fusional vergence ranges, the accommodative convergence/accommodation (AC/A) ratio, near point of convergence (NPC), stereoacuity, negative relative accommodation (NRA) and positive relative accommodation (PRA), monocular accommodative amplitude (MAA), binocular accommodative facility (BAF), oculomotor scanning, and reading speed (words per minute). The Convergence Insufficiency Symptom Survey (CISS) questionnaire was completed by all children. After the 3-month period, measurements were repeated with the yellow lenses (treatment group) or without the yellow lenses (without-treatment group) but with refractive correction if needed. Results: Over the 3 months, the two groups showed similar mean changes in the variables used to assess binocular vision, accommodation, oculomotor scanning, and reading speed. However, mean relative changes in convergence insufficiency symptoms differed significantly between the groups (p = 0.01). Conclusion: No effects of wearing yellow spectacles emerged on binocular vision, accommodation, oculomotor scanning, and reading speed in children with reading difficulties. The yellow filter had no effect even in children with low MAA and BAF. The reduction in visual symptoms observed in children with reading difficulties using the yellow filters was clinically insignificant. 2012 Springer-Verlag Berlin Heidelberg.

Source: EMBASE

Available in *fulltext* from *Graefe's Archive of Clinical & Experimental Ophthalmology* at ***EBSCOhost***

Available in *fulltext* at ***Graefe's Archive for Clinical and Experimental Ophthalmology***; Collection notes: On first login to a ProQuest journal you will need to select 'Athens (OpenAthens Federation)' from Select Region, and then 'NHS England' from Choose your Library.

9. Instrument for measuring relative brightness perception

Author(s) Martin T.J., Robison IV G.D.

Citation: American Journal of Ophthalmology, 1994, vol./is. 117/5(625-631), 0002-9394 (1994)

Publication Date: 1994

Abstract: Neuro-ophthalmic disorders may cause a subjective difference in the brightness perceived by each eye. We developed a unique clinical device to measure this difference. The device consists of a disk equipped with graded neutral-density filters that fits into a View-Master stereo viewer (View- Master International Group, Inc., Portland, Oregon). This device provides simultaneous viewing of a stimulus target for each eye, and is administered in a random, forced-choice format that allows assessment of patient reliability. We administered this test to 37 control subjects and 84 patients with a variety of disorders. Thirty-six of the 37 control subjects (97%) and 51 of the 84 patients (61%) had no

measured relative brightness deficit and no errors. Of the 34 subjects who had abnormal results, 21 (62%) isolated a relative brightness deficit within 0.2-log unit steps without error, and 28 (82%) did so within 0.4-log unit steps. This device proved to be a simple, reliable instrument for measuring relative brightness perception.

Source: EMBASE

10. Measurement of color matching functions using a digital micro-mirror device

Author(s) Yamauchi Y., Nakano Y., Kamata M., Okajima K., Uchikawa K., Murakami Y., Yamaguchi M., Ohyama N.

Citation: Journal of Vision, 2003, vol./is. 3/12(66a), 1534-7362 (2003)

Publication Date: 2003

Abstract: As many kinds of high-quality color imaging devices are wide spread, it is required to match color appearances between different devices. However, the tristimulus values of the stimuli in different devices are not always the same when they are visually matched. One hypothesis to explain this contradiction is that the color matching functions (CMFs) to calculate tristimulus values, defined by CIE in 1931, cannot apply to real observers as each observer has different CMFs. To test this hypothesis, we built a compact apparatus with the use of a digital micro-mirror device (DMD) to measure CMFs of individual observers. The experiment was conducted with a Maxwellian view optical system. The system can present a test stimulus whose spectral power distribution can be arbitrarily set by adjusting the power of every monochromatic light between 400 to 700 nm with a step of 10 nm. This can be realized by selectively switching DMD, on which the spectrally decomposed light using a diffraction grating is focused. We used 32 independent compound lights as a test stimulus. The observer adjusted the color of the test stimulus to match that of the reference white. We used two-degree bipartite field to present the test and the reference stimuli. Three observers conducted five to ten sessions. From those results, we estimated the individual CMFs using linear algebraic algorithm by assuming the additivity of CMFs. The CMFs obtained were different among observers, and also different from that of the CIE standard observer. The mean CMFs of these three observers, however, is similar to that of the CIE standard observer. Our results indicate that the optical system we proposed can be used for precise measurement of CMFs as well as traditional colorimeters and that there are significant differences in CMFs among observers.

Source: EMBASE

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11. Multifocal pupillographic perimetry with white and colored stimuli

Author(s) Maddess T., Ho Y.-L., Wong S.S.Y., Kolic M., Goh X.-L., Carle C.F., James A.C.

Citation: Journal of Glaucoma, August 2011, vol./is. 20/6(336-343), 1057-0829;1536-481X (August 2011)

Publication Date: August 2011

Abstract: Purpose: We investigated issues that could impair the capacity of multifocal pupilliographic perimetry to detect visual field damage. Differential blue light absorbance causes between-subject variance so we compared stimuli with differing blue content. We also quantified declining response gain at higher stimulus intensities (saturation), which can reduce sensitivity to changes in the visual field. Methods: Independent stimuli were delivered to 44 regions of both eyes whereas pupil responses were recorded under infrared illumination. Luminance-response functions were measured at 88 locations for white, yellow, and red stimuli at luminances ranging from 36 to 288 cd/m ². Response saturation was quantified by fitting power functions: Response=alphaLuminance^z, z<1 indicating declining response gain. Experiments were conducted on 2 groups containing 16 and 18 different normal subjects. The second experiment was designed to confirm the results of the first and to include red

stimuli. Results: Response saturation occurred in all visual field regions: the mean exponents ranged from 0.57+0.01 to 0.74+0.02 (mean+SE), that is up to 30 SE away from an exponent of 1 (no saturation). The stimulus-response functions appeared to be determined by luminance rather than color. Signal to noise ratios and regional visual field sensitivities were similar for all stimulus colors. Conclusions: Response saturation was a feature of all visual field locations. Stimuli with reduced blue light content produced the same signal to noise ratios as white stimuli. Given that these stimuli would not be affected by variable lens brunescence, they might be preferable for perimetry. Copyright 2011 by Lippincott Williams & Wilkins.

Source: EMBASE

12. Objective measurement of contact lens-induced conjunctival redness

Author(s) Guillon M., Shah D.

Citation: Optometry and Vision Science, September 1996, vol./is. 73/9(595-605), 1040-5488 (September 1996)

Publication Date: September 1996

Abstract: Ocular redness is the principal clinical sign of any inflammatory response affecting the anterior segment of the eye. The aims of the current investigation were: (1) to develop an objective method to quantify the severity and geographic distribution of redness, (2) to validate that technique by determining its precision and compare its finding to clinical rating, and (3) to apply this technique to evaluating the diurnal variation in ocular redness associated with daily and extended soft contact lens wear. The objective capture and analysis technique involved the following steps: (1) direct image formation on the CCD array of a high resolution, high sensitivity 3/4 inch Cohu camera via a Nikon Macrolens and (2) capture and image analysis with a PC-based dedicated transputer. The key steps were: filtering to accurately locate the limbus and electronic sectioning with differential intensity color analysis at fixed intervals away from the limbus. The technique gave a direct measurement of the number and size of the vessels present. The result obtained lead to the following conclusions: (1) the digitization and analysis of video recordings of the bulbar conjunctiva provide a precise measurement of the level of conjunctival redness, (2) subjective rating of low level of conjunctival redness, using an overall nine increment clinical scale, did not relate closely to the objective measurement of conjunctival redness, (3) for non-contact lens wearers, redness in the evening was similar to redness measured upon waking, and greater than redness 2 h postwaking. In contrast, in daily soft contact lens wearers, redness was maximal in the evening and greater than before insertion or during wear in the morning. In extended soft contact lens wearers, redness was maximal upon waking when it was greater than in the evening, and (4) digitization and analysis video recordings of the redness response of the bulbar conjunctiva are sufficiently sensitive clinical research tools to monitor diurnal variation of the inflammatory response of the anterior segment of the eye.

Source: EMBASE

Available in *fulltext* from *Optometry and Vision Science* at ***Free Access Content***

13. On the filter approach to perceptual transparency

Author(s) Faul F., Ekroll V.

Citation: Journal of vision, 2011, vol./is. 11/7, 1534-7362 (2011)

Publication Date: 2011

Abstract: In F. Faul and V. Ekroll (2002), we proposed a filter model of perceptual transparency that describes typical color changes caused by optical filters and accurately predicts perceived transparency. Here, we provide a more elaborate analysis of this model: (A) We address the question of how the model parameters can be estimated in a robust way. (B) We show that the parameters of the original model, which are closely related to physical properties, can be transformed into the alternative parameters hue H, saturation S, transmittance V, and clarity C that better reflect perceptual dimensions of perceived transparency. (C) We investigate the relation of H, S, V, and C to the physical parameters

of optical filters and show that C is closely related to the refractive index of the filter, whereas V and S are closely related to its thickness. We also demonstrate that the latter relationship can be used to estimate relative filter thickness from S and V. (D) We investigate restrictions on S that result from properties of color space and determine its distribution under realistic choices of physical parameters. (E) We experimentally determine iso-saturation curves that yield nominal saturation values for filters of different hue such that they appear equally saturated.

Source: EMBASE

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14. Quantitative assessment of commercial filter 'aids' for red-green colour defectives

Author(s) Moreland J.D., Westland S., Cheung V., Dain S.J.

Citation: Ophthalmic & physiological optics : the journal of the British College of Ophthalmic Opticians (Optometrists), September 2010, vol./is. 30/5(685-692), 1475-1313 (Sep 2010)

Publication Date: September 2010

Abstract: The claims made for 43 commercial filter 'aids', that they improve the colour discrimination of red-green colour defectives, are assessed for protanomaly and deuteranomaly by changes in the colour spacing of traffic signals (European Standard EN 1836:2005) and of the Farnsworth D15 test. Spectral transmittances of the 'aids' are measured and tristimulus values with and without 'aids' are computed using cone fundamentals and the spectral power distributions of either the D15 chips illuminated by CIE Illuminant C or of traffic signals. Chromaticities (l,s) are presented in cone excitation diagrams for protanomaly and deuteranomaly in terms of the relative excitation of their long (L), medium (M) and short (S) wavelength-sensitive cones. After correcting for non-uniform colour spacing in these diagrams, standard deviations parallel to the l and s axes are computed and enhancement factors E(l) and E(s) are derived as the ratio of 'aided' to 'unaided' standard deviations. Values of E(l) for traffic signals with most 'aids' are <1 and many do not meet the European signal detection standard. A few 'aids' have expansive E(l) factors but with inadequate utility: the largest being 1.2 for traffic signals and 1.3 for the D15 colours. Analyses, replicated for 19 'aids' from one manufacturer using 658 Munsell colours inside the D15 locus, yield E(l) factors within 1% of those found for the 16 D15 colours. 2010 The Authors, Ophthalmic and Physiological Optics 2010 The College of Optometrists.

Source: EMBASE

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Available in *fulltext* from *Ophthalmic & Physiological Optics* at ***EBSCOhost***

15. Reproducibility of a new colour test

Author(s) Burgmuller M., Pemp B., Dunavolgyi R., Sacu S., Buehl W.

Citation: Ophthalmologica, March 2014, vol./is. 231/3(177-179), 0030-3755;1423-0267 (March 2014)

Publication Date: March 2014

Abstract: Purpose: To evaluate the reproducibility of a new colour test, using the Chromatometer CM3. Methods: Twenty healthy subjects were recruited at the Department of Ophthalmology, at the Medical University of Vienna. A total of 40 eyes were tested. Both eyes were tested separately with the Chromatometer CM3. The colour test was repeated after several days. Each time, best-corrected visual acuity was tested using Snellen charts, and colour perception was tested using the Chromatometer CM3. Results: The Chromatometer CM3 showed reproducible results between the two tests at almost every

luminosity level. All 4 green-red measurements and 2 blue-yellow brightness measurements showed reproducible results between the first and second tests. Conclusion: The Chromatometer CM3 seems to be an appropriate method to detect changes in colour perception, although the red-green comparison appeared to be more precise than the blue-yellow comparison. 2014 S. Karger AG, Basel.

Source: EMBASE

16. Shade matching assisted by digital photography and computer software

Author(s) Schropp L.

Citation: Journal of Prosthodontics, April 2009, vol./is. 18/3(235-241), 1059-941X;1532-849X (April 2009)

Publication Date: April 2009

Abstract: Purpose: To evaluate the efficacy of digital photographs and graphic computer software for color matching compared to conventional visual matching. Materials and Methods: The shade of a tab from a shade guide (Vita 3D-Master Guide) placed in a phantom head was matched to a second guide of the same type by nine observers. This was done for twelve selected shade tabs (tests). The shade-matching procedure was performed visually in a simulated clinic environment and with digital photographs, and the time spent for both procedures was recorded. An alternative arrangement of the shade tabs was used in the digital photographs. In addition, a graphic software program was used for color analysis. Hue, chroma, and lightness values of the test tab and all tabs of the second guide were derived from the digital photographs. According to the CIE L*C*h* color system, the color differences between the test tab and tabs of the second guide were calculated. The shade guide tab that deviated least from the test tab was determined to be the match. Shade matching performance by means of graphic software was compared with the two visual methods and tested by Chi-square tests (alpha = 0.05). Results: Eight of twelve test tabs (67%) were matched correctly by the computer software method. This was significantly better ($p < 0.02$) than the performance of the visual shade matching methods conducted in the simulated clinic (32% correct match) and with photographs (28% correct match). No correlation between time consumption for the visual shade matching methods and frequency of correct match was observed. Conclusions: Shade matching assisted by digital photographs and computer software was significantly more reliable than by conventional visual methods. 2009 by The American College of Prosthodontists.

Source: EMBASE

17. Treatment of photosensitive epilepsy using coloured glasses

Author(s) Wilkins A.J., Baker A., Amin D., Smith S., Bradford J., Zaiwalla Z., Besag F.M.C., Binnie C.D., Fish D.

Citation: Seizure, December 1999, vol./is. 8/8(444-449), 1059-1311 (December 1999)

Publication Date: December 1999

Abstract: A recently introduced optometric technique, colorimetry, enables the perceptual effects of ophthalmic tints to be evaluated subjectively, optimized, and then prescribed in tinted spectacles. The new technique is beneficial in reducing visual stress in patients with dyslexia and migraine. We describe an open trial designed to ascertain: (1) whether the colorimetry assessment, as it is now given, is safe for the investigation of photosensitive patients in optometry clinics where colorimetry equipment is most readily available, but where EEG control is not practical; (2) what proportion of patients with photosensitive epilepsy is likely to benefit to the extent already described in individual cases; (3) whether a tint selected by colorimetry could be shown to reduce the incidence of paroxysmal epileptiform EEG activity in response to flicker and patterns, thereby validating the subjective methods and corroborating the reported seizure reduction. Twenty-four females and nine males (aged 12-43 years) took part. All the patients had suffered visually-provoked seizures, had exhibited a photoparoxysmal response on at least one previous EEG recording, and had received a diagnosis of photosensitive epilepsy. Twenty-two were currently experiencing seizures. A further EEG was recorded in all except seven cases: a routine resting record, followed by hyperventilation. Colorimetry was performed after

hyperventilation and before photic stimulation. Twenty-three (70%) reported beneficial effects during colorimetry and were prescribed glasses. There was a preponderance of lenses with a rose or purple colour, in contrast to patients with dyslexia. Seventeen of the 23 patients were available at follow-up, an average of 2.4 years later. Thirteen (57%) reported benefits, and said they were still using the lenses. In six of the 13 the benefits were pronounced, including a reduction of dizziness from fluorescent lighting, elimination of aura when using computer screens etc. Only in three cases was there a reduction in seizures that could reasonably be attributed to the use of lenses; in two of these cases no medications were prescribed, and in the third the medications remained unchanged for four years, two before and two after the introduction of the glasses. In an additional four cases a reduction in seizures was observed but medication had been changed. There was a modest reduction in EEG photosensitivity with the coloured lenses but also to an equivalent or lesser extent with grey in all of the eight patients examined in this way. One patient had seizures during colorimetry, but the seizures were not accompanied by scalp EEG changes.

Source: EMBASE

Available in *fulltext* from *Seizure* at ***Free Access Content***

Some additional results

Both coloured overlays and coloured lenses can improve reading fluency, but their optimal chromaticities differ.

Lightstone A, Lightstone T, Wilkins A. Ophthalmic Physiol Opt. 1999 Jul;19(4):279-85.

Some individuals read more fluently when the text is coloured: i.e., when coloured sheets of plastic (overlays) are placed upon the page, or when coloured lenses are worn. Overlays provide a surface colour whereas lenses mimic a change in the colour of a light source. The neural mechanisms that underlie colour constancy ensure that the chromaticity of overlays and lenses is processed differently by the visual system. We investigated (1) the relationship between the optimal colours of overlays and lenses, and (2) how reading rate is affected by a particular colour in overlays and lenses. In 100 patients we noted (1) the overlay(s) chosen from among the 29 combinations of the 10 IOO Intuitive Overlays which sample chromaticity systematically and (2) the chromaticity co-ordinates of the lenses subsequently chosen using the intuitive Colorimeter, a device providing a light source that can be adjusted in hue, saturation and luminance independently.

The relationship between the chromaticities of the overlays and the lenses showed considerable variation. In a second study, patients attending the Specific Learning Difficulties clinic at the Institute of Optometry, London, were given overlays to use for two months. Seventeen who derived benefit were examined using the Intuitive Colorimeter. Patients were asked to read aloud randomly ordered common words (Wilkins Rate of Reading Test): (1) with no colour, (2) with the chosen overlay, (3) with lenses matching the chosen overlay and (4) with lenses matching the Colorimeter setting. The aids increased reading rate significantly only in conditions (2) and (4). There was no significant improvement when lenses matching the overlay colour were used, and under this condition the reading rate was significantly poorer than in conditions (2) and (4). The colour of a lens will improve reading only if it is selected under conditions that mimic a change in the colour of a light source: coloured overlays give no clinically reliable guide to optimal lens colour.

Google Scholar

From the 1st fifty results:

Double-masked placebo-controlled trial of precision spectral filters in children who use coloured overlays

AJ Wilkins, BJW Evans, JA Brown… - Ophthalmic and …, 1994 - Wiley Online Library
... the second pair of **lenses** (control or experimental) and, after an interval without any

coloured filters of **...** a further 1 month period of observation ensued with the second pair of **tinted** spectacles **...** the points in Figure I. A line joins the chromaticity of the experimental **lens** (open symbol **...**
Cited by 117 Related articles All 6 versions Cite Save

Tinted lenses and related therapies for learning disabilities–a review

BJW Evans, N Drasdo - Ophthalmic and Physiological Optics, 1991 - Wiley Online Library
... tint, and when Whiting'^ described how the Irlcn Institute had evolved from using **coloured** paper to **...** the claims that these **tinted lenses** can only be supplied by the frlen Institute, and that a tint **...** The finding that the eolour of light that Irlen **lens** wearers chose to illuminate printed text **...**
Cited by 62 Related articles All 4 versions Cite Save

fMRI evidence that precision ophthalmic tints reduce cortical hyperactivation in migraine

J Huang, X Zong, A Wilkins, B Jenkins, A Bozoki… - …, 2011 - cep.sagepub.com
... To hold the **tinted lenses**, a transparent plastic frame was placed between the eyes and the **...** scored visual discomfort test in which the gray **lens** and the control **coloured lens** also showed **...** cortical activations in the extra-striate areas were suppressed by the POT **lenses** (Figure 4B **...**
Cited by 28 Related articles All 7 versions Cite Save More

Published Research – Database Search Strategy

Subsequent search

1	MEDLINE	(precision adj2 tint* adj2 "colo* lens*").ti,ab	0
2	MEDLINE	"precision tinted lens*".ti,ab	3
3	MEDLINE	(precison adj2 (tint* OR colour* OR colour*) adj0 lens*).ti,ab	0
4	MEDLINE	(tint* adj2 lens*).ti,ab	154
5	MEDLINE	((colour* OR colour*) adj2 lens*).ti,ab	41
6	MEDLINE	(precision adj2 lens*).ti,ab	18
7	MEDLINE	precision.ti,ab	76219
8	MEDLINE	4 OR 5	188
9	MEDLINE	7 AND 8	7
10	MEDLINE	((tint* OR color* OR colour*) adj2 lens*).ti,ab	300
11	MEDLINE	((tint* OR color* OR colour*) adj2 (overlay* OR lens*)).ti,ab	423
12	MEDLINE	(already adj2 (tinted OR coloured OR colored)).ti,ab	2
13	MEDLINE	(exact* OR prescri* OR accurat* OR custom* OR bespoke).ti,ab	587886
14	MEDLINE	"made to order".ti,ab	1238
15	MEDLINE	13 OR 14	589052
16	MEDLINE	7 OR 15	654201
17	MEDLINE	(already OR pre OR "standard set").ti,ab	502001
18	MEDLINE	16 OR 17	1130701
19	MEDLINE	11 AND 18	73
20	MEDLINE	(color OR colour).ti,ab	108585
21	MEDLINE	exp COLOR VISION DEFECTS/	3593
22	MEDLINE	((color OR colour) adj2 (disorder* OR defect* OR problem* OR disease*)).ti,ab	1304
23	MEDLINE	21 OR 22	4289

24	MEDLINE	19 AND 23	1
25	MEDLINE	19 AND 20	37
26	MEDLINE	11 AND 20	219
27	MEDLINE	2 OR 4 OR 5 OR 6 OR 11	438
28	MEDLINE	23 AND 27	18
29	MEDLINE	18 AND 27	88
30	MEDLINE	((tint* OR color* OR colour*) adj2 (filter*)).ti,ab	535
31	MEDLINE	18 AND 30	65
32	EMBASE	(precision adj2 tint* adj2 "colo* lens*").ti,ab	0
33	EMBASE	"precision tinted lens*".ti,ab	3
34	EMBASE	(precison adj2 (tint* OR colour* OR colour*) adj0 lens*).ti,ab	0
35	EMBASE	(tint* adj2 lens*).ti,ab	166
36	EMBASE	((colour* OR colour*) adj2 lens*).ti,ab	37
37	EMBASE	(precision adj2 lens*).ti,ab	15
38	EMBASE	precision.ti,ab	84609
39	EMBASE	35 OR 36	198
40	EMBASE	38 AND 39	7
41	EMBASE	((tint* OR color* OR colour*) adj2 lens*).ti,ab	314
42	EMBASE	((tint* OR color* OR colour*) adj2 (overlay* OR lens*)).ti,ab	449
43	EMBASE	(already adj2 (tinted OR coloured OR colored)).ti,ab	1
44	EMBASE	(exact* OR prescri* OR accurat* OR custom* OR bespoke).ti,ab	722704
45	EMBASE	"made to order".ti,ab	1549
46	EMBASE	44 OR 45	724151
47	EMBASE	38 OR 46	794913
48	EMBASE	(already OR pre OR "standard set").ti,ab	659004
49	EMBASE	47 OR 48	1413351
50	EMBASE	42 AND 49	76
51	EMBASE	(color OR colour).ti,ab	121940
52	EMBASE	exp COLOR VISION DEFECTS/	3381
53	EMBASE	((color OR colour) adj2 (disorder* OR defect* OR problem* OR disease*)).ti,ab	1299
54	EMBASE	52 OR 53	4110
55	EMBASE	50 AND 54	1
56	EMBASE	50 AND 51	44
57	EMBASE	42 AND 51	231
58	EMBASE	33 OR 35 OR 36 OR 37 OR 42	461
59	EMBASE	54 AND 58	16
60	EMBASE	49 AND 58	88
61	EMBASE	((tint* OR color* OR colour*) adj2 (filter*)).ti,ab	396
62	EMBASE	49 AND 61	66
63	EMBASE	50 OR 56 OR 59 OR 60 OR 62	157
64	CINAHL	(precision adj2 tint* adj2 "colo* lens*").ti,ab	0
65	CINAHL	"precision tinted lens*".ti,ab	0
66	CINAHL	(precison adj2 (tint* OR colour* OR colour*) adj0 lens*).ti,ab	0
67	CINAHL	(tint* adj2 lens*).ti,ab	14
68	CINAHL	((colour* OR colour*) adj2 lens*).ti,ab	1
69	CINAHL	(precision adj2 lens*).ti,ab	1

70	CINAHL	precision.ti,ab	3141
71	CINAHL	67 OR 68	15
72	CINAHL	70 AND 71	0
73	CINAHL	((tint* OR color* OR colour*) adj2 lens*).ti,ab	19
74	CINAHL	((tint* OR color* OR colour*) adj2 (overlay* OR lens*)).ti,ab	26
75	CINAHL	(already adj2 (tinted OR coloured OR colored)).ti,ab	0
76	CINAHL	(exact* OR prescri* OR accurat* OR custom* OR bespoke).ti,ab	69865
77	CINAHL	"made to order".ti,ab	18
78	CINAHL	76 OR 77	69882
79	CINAHL	70 OR 78	72459
80	CINAHL	(already OR pre OR "standard set").ti,ab	44720
81	CINAHL	79 OR 80	114748
82	CINAHL	74 AND 81	2
83	CINAHL	(color OR colour).ti,ab	5406
84	CINAHL	exp COLOR VISION DEFECTS/	81
85	CINAHL	((color OR colour) adj2 (disorder* OR defect* OR problem* OR disease*)).ti,ab	54
86	CINAHL	84 OR 85	125
87	CINAHL	82 AND 86	0
88	CINAHL	82 AND 83	1
89	CINAHL	74 AND 83	9
90	CINAHL	65 OR 67 OR 68 OR 69 OR 74	27
91	CINAHL	86 AND 90	0
92	CINAHL	81 AND 90	0
93	CINAHL	((tint* OR color* OR colour*) adj2 (filter*)).ti,ab	13
94	CINAHL	81 AND 93	0
95	CINAHL	82 OR 88 OR 91 OR 92 OR 94	0
96	CINAHL	73 OR 74 OR 82 OR 88 OR 89 OR 90 OR 93	38

Initial search

1	CINAHL	((color* OR colour* OR tint*) adj2 (lens* OR glasses OR spectacles) adj2 prescribe*).ti,ab	0
2	CINAHL	((color* OR colour* OR tint*) adj2 (lens* OR glasses OR spectacles)).ti,ab	43
3	CINAHL	colorimetry.ti,ab	21
4	CINAHL	colorimetr*.ti,ab	322
5	CINAHL	COLORIMETRY/	337
6	CINAHL	spectrophotometr*.ti,ab	511
7	CINAHL	SPECTROPHOTOMETRY/	762
8	CINAHL	(prescribe* OR prescript*).ti,ab	25627
9	CINAHL	PRESCRIPTIONS, NON-DRUG/	483
10	CINAHL	2 OR 4 OR 5 OR 6 OR 7	1651
11	CINAHL	8 OR 9	25627
12	CINAHL	10 AND 11	9

13	CINAHL	((color* OR colour* OR tint*) adj2 (lens* OR glasses OR spectacles OR filter*)).ti,ab	54
14	CINAHL	4 OR 5 OR 6 OR 7	1608
15	CINAHL	((photochromic OR light-adaptive) adj2 (lens* OR glasses OR spectacles OR filter*)).ti,ab	0
16	CINAHL	((measure* OR evaluat* OR assess* OR analys*) adj2 (intensity* OR concentration* OR hue OR saturation OR brightness)).ti,ab	4897
17	CINAHL	13 OR 15	54
18	CINAHL	16 AND 17	0
19	EMBASE	((color* OR colour* OR tint*) adj2 (lens* OR glasses OR spectacles) adj2 prescribe*).ti,ab	7
20	EMBASE	((color* OR colour* OR tint*) adj2 (lens* OR glasses OR spectacles)).ti,ab	427
21	EMBASE	colorimetry.ti,ab	2393
22	EMBASE	colorimetr*.ti,ab	22639
23	EMBASE	COLORIMETRY/	24420
24	EMBASE	spectrophotometr*.ti,ab	44851
25	EMBASE	SPECTROPHOTOMETRY/	59982
26	EMBASE	(prescribe* OR prescript*).ti,ab	172902
27	EMBASE	PRESCRIPTIONS, NON-DRUG/	112449
28	EMBASE	20 OR 22 OR 23 OR 24 OR 25	116643
29	EMBASE	26 OR 27	221805
30	EMBASE	28 AND 29	287
31	EMBASE	((color* OR colour* OR tint*) adj2 (lens* OR glasses OR spectacles OR filter*)).ti,ab	802
32	EMBASE	22 OR 23 OR 24 OR 25	116234
33	EMBASE	((photochromic OR light-adaptive) adj2 (lens* OR glasses OR spectacles OR filter*)).ti,ab	33
34	EMBASE	((measure* OR evaluat* OR assess* OR analys*) adj2 (intensity* OR concentration* OR hue OR saturation OR brightness)).ti,ab	73750
35	EMBASE	31 OR 33	830
36	EMBASE	34 AND 35	3
37	EMBASE	28 OR 34	189016
38	EMBASE	35 AND 37	491
39	EMBASE	orthopti*.ti,ab	1349
40	EMBASE	ORTHOPTICS/	1728
41	EMBASE	39 OR 40	2387
42	EMBASE	38 AND 41	2
43	EMBASE	(intensity* OR concentration* OR hue* OR saturation OR brightness OR color* OR colour* OR tristimulus).ti,ab	2191414
44	EMBASE	(colorimeter* OR spectro*).ti,ab	490231

45	EMBASE	(lens* OR glasses OR spectacles OR filter*).ti,ab	189111
46	EMBASE	(intensity* OR concentration* OR hue* OR saturation OR brightness OR color* OR colour* OR tristimulus OR tint*).ti,ab	2192243
47	EMBASE	45 AND 46	32384
48	EMBASE	((measure* OR evaluat* OR assess* OR analys* OR calbrat* OR calculate* OR gaug* OR quantif* OR determin*) adj2 (intensity* OR concentration* OR hue* OR saturation OR brightness OR tristimulus)).ti,ab	111929
49	EMBASE	45 AND 48	2260
50	EMBASE	((measure* OR evaluat* OR assess* OR analys* OR calbrat* OR calculate* OR gaug* OR quantif* OR determin*) adj2 (intensity* OR concentration* OR hue* OR saturation OR brightness OR tristimulus) adj2 (color OR colour OR tint*)).ti,ab	85
52	EMBASE	(opth* OR orthoptic* OR optom* OR eye*).ti,ab	305932
53	EMBASE	48 AND 52	1161
54	EMBASE	45 AND 53	126
55	EMBASE	54 [Limit to: Human and English Language]	56
56	EMBASE	COLOR VISION/	13932
57	EMBASE	48 AND 56	61
58	EMBASE	57 [Limit to: Human and English Language]	46
59	EMBASE	exp VISUAL IMPAIRMENT/ [Limit to: Human and English Language]	51072
60	EMBASE	exp VISUAL DISORDER/ [Limit to: Human and English Language]	123323
61	EMBASE	48 AND 60 [Limit to: Human and English Language]	174
62	EMBASE	(color OR colour OR tint*).ti,ab [Limit to: Human and English Language]	62743
63	EMBASE	61 AND 62 [Limit to: Human and English Language]	12
64	EMBASE	31 AND 60 [Limit to: Human and English Language]	81
65	EMBASE	49 AND 62 [Limit to: Human and English Language]	19