

PRIMARY eye care

In this issue...

we take a look at recent research investigating the effects of myopia correcting lenses and eye fatigue, the effects of brief periods of monocular deprivation on ocular balance in the human adult visual cortex, and for light relief, eye trauma in Laurel and Hardy movies.

Myopia-correcting lenses decrease eye fatigue in a visual search task for both adolescents and adults

A 2021 study led by Hyeongsuk Ryu of Department of Brain and Cognitive Engineering, Korea University, and co-authors Uijong Ju and Christian Wallraven found a clear reduction of fatigue levels in both adolescents and adults when wearing Defocus Incorporated Multiple Segment (DIMS) correcting lenses.

As background the study notes that it is estimated that by 2050 the global myopia prevalence will be around 5 billion people, and although it is a non-life-threatening disorder, myopia has far-reaching consequences in the health sector resulting in significant social and economic spending on both personal and national levels.

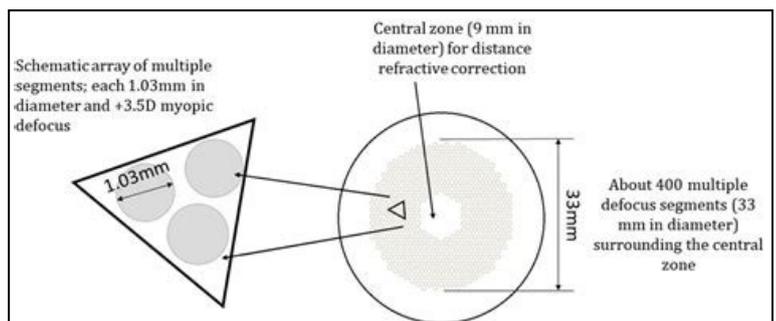
While it is accepted that one of the major optical sources of myopia stems from an excessive elongation of the eye's axial length that happens during childhood growth there have been suggestions that societies' increase in near-work activities and an accompanying indoor lifestyle is associated with increased risk of myopia. These factors have likely been exacerbated by the COVID-19 pandemic with extended lockdowns, home-schooling, reduced outdoor activities, and the increasing dependence on electronic devices for communication.

There are a variety of options available for intervention to reduce the progression of myopia including optical intervention using defocus incorporated multiple segments (DIMS) spectacle lenses. DIMS lenses have a central 9mm zone of full myopia correction, while the peripheral of the lens has plus power defocused lenslets evenly spaced throughout. These lenses do not share the side effects of pharmaceutical treatments, nor do they require special care as contact lenses do.

In a clinical trial following young children for two years, Lam et al* found that myopia progressed 52% more slowly for children in the DIMS group compared with those in the SV group plus children in the DIMS group had less axial elongation by 62% than those in the SV group. Nearly a quarter (21.5%) of children who wore DIMS lenses had no myopia progression over 2 years, while only 7.4% of those using SV lenses had no myopia progression.

However, as Ryu and colleagues noted, clinical trials have typically focused on the assessment of the main outcome variable of myopia progression while a factor that has received comparatively little attention is that of eye fatigue or eye strain (asthenopia).

Although it is well known that changing the refractive power in prescriptions for people with myopia or astigmatism is often accompanied by symptoms such as asthenopia, headache, or dizziness, these issues have not been well researched in respect of changes introduced by myopia control lenses. Given that the DIMS lenses change the refractive power of a subpart of the visual field, Ryu et al provide a greater understanding of the impact of such differences in wearing comfort.



The study investigated perceived fatigue levels according to lens type (standard myopia correction vs DIMS) and age (adolescents vs adults) in a demanding visual search task using the "Where's Wally" puzzle. This game in which a target figure has to be found in a highly-cluttered visual environment containing lots of distractor objects was presented in two difficulty levels (easy vs difficult).

Visual search is a core perceptual task, involving the search for a particular target among a (usually complex) background and the “Where’s Wally” game is one example of a visual search task. Previous research has shown that visual search performance critically depends on age, and there is some evidence that eye fatigue during game play also is different by age.

The Ryu et al study found no significant main effect for either age or task difficulty in respect to eye fatigue, however, a clear reduction of fatigue levels was found in both age groups when wearing the DIMS correcting lenses. This suggests, the additional accommodation of these lens types may result in less strain in a task requiring sustained eye movements at near viewing distances.

All participants were provided spectacles with DIMS lenses and given at least 14 days to adapt to the multi-focal effects. They were monitored by phone call during this adaptation period and asked to report any wearing discomfort (such as dizziness or headache). Participants responded that discomfort disappeared after a maximum of 7 days.

Data analysis

Dependent variables were accuracy, response time, and perceived eye fatigue. These were analysed for the experimental factors of age group (Adult v Adolescents), lens type (SV v DIMS), and difficulty (Easy v Difficult).

Results

Accuracy showed a significant main effect of age group with adults having an average of 10% higher accuracy.

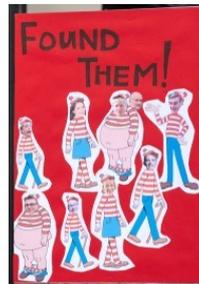
Response time was also slightly faster on average for the adult group and there was a main effect of difficulty with Easy images being on average around 18s faster to solve than Difficult images.

Eye fatigue

Results for eye fatigue showed main effects of lens type and difficulty. Eye fatigue levels were higher for Difficult than for Easy images. The main effect of lens type showed that DIMS lenses significantly reduced eye fatigue on average by 23% over SV. Both groups’ fatigue levels were reduced considerably by the DIMS lenses. No evidence was found for interactions. Both response time and eye fatigue developed over the course of the experiment and the two measures are also correlated significantly ($p < .001$). Importantly, though, levels of these measures stay continuously lower for DIMS lenses than for single vision lenses across all trials.

One potential explanation for the decrease in eye strain/ eye fatigue while wearing the DIMS lenses may be related to changes in accommodation stemming from the additional optical power of the lens and associated reduction in ciliary muscle stress.

Another possibility for the reduced eye strain may lie in the fact that visual processing of information and ongoing attentional processes are impacted by the optical setup of the DIMS lenses where information beyond the central 13 degrees is blurred to some degree.



The amount of information that needs to be processed (peripherally) is reduced compared to SV lenses. In post-experiment debriefing participants reported that the DIMS lenses yielded a subjectively better wearing comfort and enabled them to “concentrate better” during the demanding visual search task.

Citation: Ryu H, Ju U, Wallraven C (2021) Myopia- correcting lenses decrease eye fatigue in a visual search task for both adolescents and adults. PLoS ONE 16(10): e0258441. <https://doi.org/10.1371/journal.pone.0258441>

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* Lam CSY, Tang WC, Tse DY-y, Lee RPK, Chun RKM, Hasegawa K, et al. Defocus Incorporated Multiple Segments (DIMS) spectacle lenses slow myopia progression: a 2-year randomised clinical trial. *British Journal of Ophthalmology*. 2020; 104(3):363–8. <https://doi.org/10.1136/bjophthalmol-2018-313739> PMID: 31142465. This is an open access article

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Brief periods of monocular deprivation disrupt ocular balance in human adult visual cortex

This brief correspondence in *Current Biology* from 2011 caught our interest because of the suggestion that the adult visual cortex retains a good deal of plasticity that could be important in reaction to sensory loss.

Claudia Lunghi (Universita di Firenze) and colleagues David Burr (Institute of Neuroscience CNR – Pisa) and Concetta Morrone (Universita di Pisa), reported that 150 minutes of monocular deprivation strongly affects the dynamics of binocular rivalry, unexpectedly causing the deprived eye to prevail in conscious perception twice as much as the non-deprived eye, with significant effects for up to 90 minutes.

In the study seven observers each wore a translucent eye-patch on one eye for 150 minutes, then viewed a dichoptic binocular-rivalry display with horizontal grating patches presented to one eye and vertical to the other. While viewing the grating display, the participants reported by continuous key-press which pattern they perceived, recording the phases in which each eye 'dominated'. This continued for five contiguous three minute sessions.

Immediately after eye-patch removal, phase duration

(domination) of the deprived-eye pattern increased by 53%, while those of the non-deprived eye decreased by 24%. The difference in phase duration between the two eyes decayed steadily over time, but remained significant 15 minutes after eye-patch removal (paired t-test, $n = 11$, $a = 0.025$, $p < 0.01$). Despite the strong bias towards the deprived eye, the quality of binocular rivalry did not change after deprivation, with continued alternations between the two monocular images, with almost no periods of fused images.



In the first session the deprived eye dominated in 93% of first-phases, and even after 90 minutes, the bias towards the deprived eye remained significant (64%: sign test, $n = 49$, $a = 0.025$, $p < 0.001$). After deprivation, gratings viewed by the deprived eye appeared of higher contrast than those by the non-deprived eye. The increase in apparent contrast is qualitatively consistent with the relatively shorter binocular phase periods to the non-deprived eye, but the amount of increase is quantitatively insufficient to explain the imbalance in rivalry.

Overall, the present results demonstrate that abnormal visual experience can affect adult vision. The observed effects probably reflect transient changes in neuronal circuitry in primary visual cortex, possibly related to calibration of the system. That binocular rivalry can reveal significant neural plasticity in adult visual cortex suggests that it could become an important non-invasive tool to assess reorganization of the visual cortex in a range of visual pathologies.

Citation: Lunghi, C., Burr, D., Morrone, C., (2011) Brief periods of monocular deprivation disrupt ocular balance in human adult visual cortex. *Current Biology - Cell Press, Correspondence Volume 21, ISSUE 14, PR538-R539, Open Archive DOI: <https://doi.org/10.1016/j.cub.2011.06.004>*

And now for some light relief:

Eye trauma in Laurel and Hardy movies – another nice mess

This study was thrown up in a recent search for information on eye trauma and we could not resist reporting on it in this issue of Primary Eye Care. Although the full paper is not available in Open Access,

we were able to locate the abstract copied below in PubMed and which is reproduced here for both edification and entertainment.

One of the characteristics in Laurel and Hardy films is a lot of physical violence. The Zegers & Zegers (2016) study examines the occurrence of eye trauma in Laurel and Hardy movies and discusses the impact that could have been had if the films were set in reality.

[i.e., if the eye-poking had been real and not just pretend]

Methods and results

All 92 movies starring Laurel and Hardy as a pair in leading roles were watched together by the authors and were scored for any eye trauma. Eighty-eight eye traumas happened, of which 48% were directed at Hardy. The eye poke was the most frequently occurring eye trauma and the traumatic corneal abrasion was very likely the most frequently occurring injury. Among the most serious causes of eye trauma were the pin of a door handle, a stick, a champagne cork, a tree branch and tacks.

Conclusion

Without a doubt, if their films had been reality, especially Hardy but also Laurel and several other people, would have suffered from serious eye injuries caused by the 88 eye traumas. The findings of the present study might reflect the personality, character and intellectual capacity of both Laurel and Hardy as 'Two Minds Without a Single Thought'.



Citation: Zegers LD, Zegers RH. Eye trauma in Laurel and Hardy movies - another nice mess. *Scott Med J.* 2016 Nov;61(4):207-212. doi: 10.1177/0036933016680160. Epub 2016 Nov 17. PMID: 27856946.

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