

Kongsberg Vision Meeting 2018: Abstracts

Kongsberg Vision Meeting was held at the University of South-Eastern Norway in Kongsberg, for the eleventh time, on October 30–November 1, 2018. The meeting was organised as a three-day meeting with a clinical day, research day and a lighting design day. Rigmor C. Baraas, Helle K. Falkenberg, Veronika Zaikina and Are Røysamb organised the three-day meeting. The theme this year was Vision Impairment, Elderly and Light. Keynote speakers for the clinical optometry day and the research day were Susana Chung and Ava Bittner. The keynote speakers for the light day were Mariana Figueiro. The abstracts from invited and contributed talks on the research day and the light day are presented in the order they were given.

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Characteristics and functional role of fixational eye movements in people with macular disease

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Abstract

People with macular disease are known to exhibit abnormal fixational eye movements (FEMs). Do these abnormal FEMs limit the functional vision of individuals with macular disease? In this talk, I will describe a series of experiments that we performed to understand the characteristics and functional role of FEMs in people with macular disease. In the first experiment, we used a scanning laser ophthalmoscope to record FEMs in human adults with macular disease while participants monocularly fixated a fixation cross. Eye position data were recovered using a cross-correlation procedure. When compared with age-matched adults with normal vision, participants with macular disease demonstrated higher fixation instability, larger amplitudes of slow drifts and microsaccades. However, do these abnormal FEMs impact functional vision for people with macular disease? A recent theory posits that *normal* FEMs serve to reformat the visual input of natural images, so that the amplitude of the spatial frequencies of the input image is equalised across a range of frequencies (“spectral whitening”), thus improving the processing of high spatial frequency information. Do the abnormal FEMs exhibited by people with macular disease also result in spectral whitening? In a second experiment, we created “movies” of how natural scene images moved across the retina according to FEMs of individual participants and analysed the power spectra of these movies. In general, participants with macular disease also demonstrated spectral whitening, but the amount of whitening was less than that obtained in participants with normal vision. This finding does not directly imply whether FEMs are beneficial, or detrimental, to fine spatial tasks for individuals with macular disease. In the final experiment, we measured the performance for identifying the orientation of a grating that was stabilised on the retina with different stabilisation gains so that we could systematically evaluate the effects of retinal image motion on performance. For participants with normal vision, the best performance occurred not at values of retinal image motion corresponding to their FEMs, but at a stabilisation gain of 0.43, meaning that normal vision could benefit from more stable FEMs. Participants with macular disease showed

more idiosyncrasies — performance was maximal with their FEMs in some cases; while in other cases, performance would benefit from either more, or less retinal image motion. Implications of these results, especially in relation to low vision rehabilitation, will be discussed.

Acknowledgements

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Vision in congenital aniridia

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Abstract

Aniridia is a congenital disorder where the development of the eye is affected, usually caused by a mutation in the *PAX6* gene. A mutation can lead to a spectrum of ocular anomalies, including iris- and foveal hypoplasia, and can cause severely impaired vision (Landsend et al., 2018). To date, 491 unique *PAX6* gene mutations have been identified (“Human *PAX6* Allelic Variant Database (LOVD Database)”, 2018), but our knowledge of the implications of these mutations is limited. The focus of this research has been to increase knowledge about the complexity and variation in retinal development and how this correlates with visual function in aniridia.

Participants with congenital aniridia and healthy participants with normal vision were enrolled in the study. We combined computerized colour vision tests and retinal imaging to examine colour vision and the degree of arrested foveal formation in congenital aniridia compared to normal controls. To investigate the retinal structure, we used high-resolution imaging techniques: Heidelberg Spectralis OCT2 to measure the thickness of the retinal layers, and the Kongsberg Adaptive Optics Scanning Light Ophthalmoscope (AOSLO) to image the photoreceptors at a cellular level.

Individuals with congenital aniridia have a quantifiable loss of red-green colour discrimination which correlates with their degree of foveal hypoplasia. Some have an additional, quantifiable loss of blue-yellow colour discrimination, but this is typically associated with secondary pathology like glaucoma (Pedersen et al., 2018). We observed significantly fewer cone photoreceptor cells within the macular area in participants with aniridia compared to normals. Furthermore, there was a large between-individual variation in retinal structure and foveal development among family members possessing an identical *PAX6* mutation. Variable relationship between foveal hypoplasia, visual acuity and colour vision suggests that visual function in aniridia is also a consequence of disrupted development of post-receptor neurons and associated pathways. There was a poor association, if any, between the degree of iris- and foveal hypoplasia, which underscores the importance of a thorough retinal examination, also for those family members apparently unaffected by aniridia.

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The role of dry eye disease in the serious and complex ocular disorder aniridia

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Abstract

Congenital aniridia is caused by fundamental disturbances in development of the eye, in most cases explained by a mutation in the *PAX6* gene. The condition is primarily characterized by hypoplasia of the iris and the retinal fovea. Severe, secondary complications are common, including aniridia associated keratopathy (AAK) which may cause severe pain and visual impairment. An association between AAK and dry eye disease (DED) was previously suggested. We examined 35 aniridia patients and 21 healthy controls, and performed a thorough DED examination. In aniridia, increased tear film osmolarity, ocular surface staining, loss of meibomian glands, and lower meibomian gland expressibility was found. Tear fluid analyses showed elevated concentrations of several pro-inflammatory cytokines in aniridia. A correlation between cytokine levels and parameters for meibomian gland dysfunction (MGD) was detected. In conclusion, patients with congenital aniridia have more severe signs of DED than healthy individuals. Moreover, increased inflammation of the ocular surface may be a factor in the development of MGD and DED in this patient group.

Electrostimulation therapy for retinitis pigmentosa

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Abstract

A small-scale randomized controlled trial conducted by our group found that four out of seven retinitis pigmentosa (RP) subjects who received six weekly Transcorneal Electrical Stimulation (TES) sessions developed significant improvements in visual acuity (VA), quick contrast sensitivity function (qCSF), and/or Goldmann visual fields (GVF) (Bittner et al., 2018). We previously reported that three of these participants who received TES retreatments over 29-35 months had visual improvements that lasted for several months after each six-week course of TES (Bittner & Seger, 2018), thus we hypothesized it may be possible to restore and prevent slowly diminishing visual loss over time with retreatments. We now

report findings for two of these participants who continued to receive retreatments for 41-48 months following initial TES. Subjects 1 and 2 completed ETDRS VA, qCSF and/or GVF tests at 43 and 16 visits, while receiving eight and five TES treatment courses in both eyes every 4-8 and 10-13 months, respectively. Subjects 1 and 2 were 34- and 44-year-old women at baseline with vision loss since birth or childhood due to autosomal recessive (Bardet-Biedl syndrome) and autosomal dominant RP, respectively. We compared visual function measures obtained 4-6 weeks after the completion of each retreatment course (i.e., hypothesized peak of treatment effect) to results at all other evaluation times. Subject 1 had an initial improvement in binocular VA of 0.12 logMAR, which increased statistically significantly by 0.05 logMAR on average during the 41-month retreatment period ($p = 0.03$). After the initial TES course, subject 1's binocular qCSF sensitivity at 1.5 cycle per degree (cpd) improved by 0.32 logCS, then maintained an average improvement of 0.20 logCS across all assessments over 41 months, which did not change significantly during the assessment period ($p = 0.09$); the magnitude of these CS improvements from baseline exceeds the previously published test-retest variability (95% coefficient of repeatability) of 0.16 logCS for this measure in RP (Bittner & Seger, 2018). When comparing baseline to 48 months, subject 2 did not have a significant loss in VA (OD: no change; OS: improved 0.74 logMAR; OU: improved 0.52 logMAR), or binocular qCSF at 1.5 cpd (no change). Subject 1 and 2's mean annual GVF changes were -3.8% to +4% in each eye with the V4e and III4e stimuli across 41-48 months ($p = 0.31-0.86$), with the exception of the III4e stimulus in subject 2's right eye, for which we previously reported a significant loss of -26% GVF area between the first and second treatment courses ($p = 0.01$) (Bittner & Seger, 2018), but did not demonstrate a continued significant loss from 12-48 months (-7%; $p = 0.46$). Both subjects' binocular VA measures were better by 0.032 and 0.20 logMAR on average at 4-6 weeks after each TES course compared to other assessment times ($p = 0.04$; $p = 0.06$). Subject 1's binocular qCSF sensitivity at 1.5 cpd was statistically significantly greater at 4-6 weeks after each TES course than other assessment times by 0.11 logCS on average ($p = 0.008$). These two RP patients who received periodic retreatments with TES did not experience a statistically significant or clinically meaningful loss of VA, qCSF and/or GVF area over 3-4 years as would typically be expected with RP.

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Evidence Based Neuro Visual Rehabilitation

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Abstract

Neuro-visual rehabilitation is a strategy that aims to recover the visual functions affected after a brain injury. Brain damage, acquired or inherited, presents physical, psychological and sensory consequences. It is estimated that 2,095,353 hospital discharges and 82,546 deaths are associated to traumatic brain damage in 2012 in Europe. Its ocular manifestation – cerebral visual impairment – generates problems in binocular vision, visual field or image processing, among others. Moreover, vision has great implications in other areas such as mobility or memory. Thus, the vision sciences professional takes a very important role within a multidisciplinary team.

There are several neurorehabilitation therapies used today, such as restoration, compensation or substitution therapies; however, perceptual learning is becoming important given its lifelong benefits, the activation of various cortical areas and the advance of technology and therapeutic video games. Nevertheless, none of them are strongly supported by the literature, due to the small sample sizes included. Serious games are currently a new therapeutic option that has been shown, in the literature, to improve cortical connections, cognitive control and multitasking in adults. On the other hand, for children with neuro-visual disorders, video games have been shown to be more effective for the treatment of amblyopia compared to traditional patch. Perceptual learning, together with advances in robotics and virtual reality, are the future of neurorehabilitation, and should be included as a therapeutic option in ad-hoc visual rehabilitation programs.

Eye-fitness: a home-based rehabilitation program for people with central vision loss

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Abstract

Low vision rehabilitation involves important challenges due to age-associated physical and psychological issues and transportation barriers. Home and tele-rehabilitation training could overcome these problems (Bittner, Wykstra, Yoshinaga, & Li, 2015; Rogante, Grigioni, Cordella, & Giacomozzi, 2010). The aim of this prospective study was to evaluate the efficacy of a customizable computer-based tele-rehabilitation program (CBRP). Patient usability was also evaluated. Nine patients with central vision loss due to Macular Degenerations were included in the study. A standardized protocol of examination was performed for all participants, before and after the home training, by measuring: best corrected visual acuity (BCVA), contrast sensitivity (CS), reading acuity (RA), fixation stability (BCEA) and reading speed (RS). The CBRP was performed using Eye-Fitness (Nidek Technologies, Padua, Italy), including 19 customizable exercises.

14 visual home-training sessions were performed daily binocularly. The mean CS was significantly improved from 0.5 (± 0.2) to 1.08 (± 0.3) LogC ($t(8) = 6.1$, $p = 0.001$) in the better eye and from 0.4 (± 0.5) LogC to 0.7 (± 0.4) LogC ($t(7) = 2.9$, $p = 0.01$) in the worse eye. Mean binocular reading performance increased from 50.6 (± 26.9) to 67.6 (± 22.7) wpm ($t(8) = 13.2$, $p = 0.001$). BCEA values were significantly smaller for the better eye (from 8.87 log minarc² (± 10.6) to 1 (± 1.79) ($t(8) = 3.4$, $p = 0.004$) and for the worse eye (from 10.6 log minarc² (± 1.9) to 2.26 (± 0.69) ($t(7) = 4.5$, $p = 0.002$). Mean accuracy and reaction time were significantly better after training (from 52.3 (± 29.7)% to 84.9 (± 19.60)%; $F = 45.30$, $p < 0.01$ and from 35.7 (± 27.7) sec to 9.3 (± 1.7) sec ($F = 80.5$, $p < 0.05$) respectively. The findings of this study provide evidence of the effectiveness of the home rehabilitation intervention for visually impaired subjects by showing an improvement of visual functions. This new technique may contribute to avoid the issues related to attending visual rehabilitation programs.

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Visual impairment after stroke; stroke survivor's experiences of acute care and follow up

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Abstract

Approximately 12000 people suffer from stroke in Norway every year. Although stroke is the third leading cause of death, many survive, and have to live with a variety of consequences after their stroke (Ellekjaer & Selmer, 2007). The prevalence of visual impairment after stroke is approximately 65% (Lauren Hepworth et al., 2015). Stroke related visual impairment is associated with depression, reduced quality of life and a lower outcome of rehabilitation (Hepworth & Rowe, 2016; Sand et al., 2016). Visual impairment after stroke is often overlooked due to lack of competency and structured assessments in acute stroke units (Lofthus & Olsvik, 2012; Rowe et al., 2015; Sand, Thomassen, Næss, Rødahl, & Hoff, 2012). There is little knowledge on how stroke survivors themselves experience acute vision care and how impaired vision affects their everyday life. To gain insight into this topic, it is important to study the stroke survivors' own experiences as they express them. The aim of this study was to explore how persons with visual impairment after stroke experience vision care support in acute care and follow-up. Further, how visual impairment affects everyday life 3 months post stroke. This study is part of a knowledge translation project (CROSS) that aims to improve assessment and follow-up of visual impairment after stroke in Norway (Falkenberg,

Langegegn, Mathisen, Ormstad, & Eilertsen, 2018). A qualitative approach with individual in-depth interviews, using a semi-structured interview guide where used. The participants were also encouraged to speak freely about their experiences. Staff at two acute stroke units recruited the participants. The interviews were conducted in the participants' own homes and lasted from 45 to 90 minutes. Interviews were recorded and transcribed verbatim. The material was analysed using qualitative content analysis as described by Graneheim and Lundmann (2014). Ten stroke survivors participated in the study, five men and five women. Their age ranged from 70 to 90 years, mean age 73.4 years. The acute inpatient treatment varied from 2 to 21 days. Some were discharged from acute care directly to their homes without follow-up. Some attended a rehabilitation institution before being discharged. Through the content analysis, we found that visual impairment after stroke affects many aspects of life. Lack of personalized information and support negatively impacts the rehabilitation and coping process. It can be a challenge to identify sudden visual impairment as a symptom of stroke. Personalized and evidence-based information in acute and rehabilitation services about strategies to improve visual function, supportive vision aids and coping strategies may contribute to a better way of adapting to life with visual impairment after stroke. There is a need for better information towards the public and non-acute health care workers in how to react when acute visual impairment occurs. A more standardized clinical pathway could secure a better follow-up.

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- thus lack of aids, reduces the capability and increases the risk of not being able to carry out ordinary, everyday tasks, and it may lead to a negative spiral of isolation and depression.
- Eye examinations were performed in Danish nursing homes including visual acuity (VA) with logMar charts, contrast sensitivity for near, refraction measured using Retinomax, slit lamp examination, intraocular pressure measured with iCare and an OcularCoherenceTomography (OCT) examination of fundus.
- Out of 502 residents it was possible to examine 371 and the rest were unable to participate. VA better than 6/18 was seen in 52%, another 22% were visually impaired with VA of between 6/18 and 6/60 or constriction of the visual field and 13% were blind with VA \leq 6/60. In 13% of the residents, it was not possible to measure the visual acuity
- The number of persons who had undergone cataract surgery increased with age: 14 (14%) under 80 years had undergone surgery, 50 (33%) between 80 and 90, and 51 (43%) over 90 years of age. In 127 cases slit lamp examination showed lens opacities, and 78 were referred for surgery.
- The frequency of residents diagnosed with glaucoma increased with age so that there were 3 (3%) in the group under 80 years, 9 (6%) between 80 and 90 years, and 10 (9%) among residents over 90 years of age.
- 117 individuals were examined with OCT. In addition to these 117, a number of images had to be discarded, since the quality was poor. Upon reviewing the images, 58 individuals were found to have AMD, 23 drusen, 7 changes in the papilla and 29 were normal.
- In 159 cases the staff did not think that the resident had vision problems. Of these 119 had normal VA, consistent with the view of staff, but in 40 cases the resident was in fact visually impaired or blind. This means that among 159 residents, there is one fourth about which staff is not aware of any vision handicap. On the other hand, in 154 cases the staff felt that the resident had vision problems, but in 95 of these no impairment was detected.
- Information is lacking on eye diagnoses in residents' medical journals, and the staff lack knowledge about the significance of eye diseases. A recent eye status in any person referred to a nursing home, will give better likelihood of assessing the resident, and the staff can be familiar with the requirements of each resident (which eye glasses and level of functioning, need for lightening or optical aids). In cases of later loss of visual function, staff may refer the resident to an ophthalmologist for assessment, or, in cases of recognised, potential diagnosis of blindness (AMD), may support and guide based on knowledge.

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Considering the concepts of the lived body and the lifeworld as tools for better understanding the meaning of assistive technology in everyday life

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Abstract

The lives of individuals with physical or perceptual impairments are often filled with various objects that support daily

Elderly in nursing homes – problems to be aware of!

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Abstract

It is well known that the elderly have a higher prevalence of primary eye diseases as well as systemic diseases with eye complications. Lack of information on loss of function and

activities and are generally referred to as assistive technologies. These are usually understood as objects relating to individuals' functional capabilities. In this presentation, assistive technology is instead interpreted and explored in its subjective and social meaning by drawing on continental philosophy within a framework of lifeworld phenomenology and hermeneutics, putting forward existence, embodiment and the sociality of the lifeworld. The long cane as used by visually impaired and blind people is discussed as an example, based on results from two empirical studies. Three themes or dimensions stood out in the analysis: one relating to intersubjectivity and the social world, another relating to embodiment and the lived space, and one in which the long cane is interpreted as a tool for building a new world. These dimensions have been discussed individually in philosophical terms to some degree. However, here they are intertwined and analysed based on empirical research on individuals in the process of learning or using the long cane in everyday life, which gives new meaning to the researched subject.

The effects of simulated cataracts on visuomotor performance

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Abstract

Cataract surgery is the most commonly performed surgical procedure in the UK, but there has recently been some debate over the clinical and cost-effectiveness of second-eye surgery for bilateral cataracts. Whilst research has been conducted looking at the implications of this for visual measures and quality of life (Frampton, Harris, Cooper, Lotery, & Shepherd, 2014) the effects on visuomotor skills that underpin numerous activities of daily living remain under-researched. There is therefore an urgent scientific need to determine the functional benefits of one-eye vs. bilateral surgery. Data from two studies will be presented. Firstly, we explored the impact of monocular vs. binocular viewing on visuomotor control. We tested young adults ($n = 72$, mean age = 20) on tracking, steering and aiming tasks (fundamental visuomotor transformations involved in many activities of daily living) under monocular and binocular viewing conditions. Measures of visual acuity, stereopsis and contrast sensitivity were also recorded for each participant in each visual condition. The results showed decreased performance with monocular viewing despite the movements being made on a plane where there was no useful information from stereopsis. As such, even small decreases in visual sensitivity can have functional implications for visuomotor online control. Secondly, we used Bangerter foils to simulate monocular and bilateral cataracts in young adults ($n = 30$, mean age = 19) to examine the effects of reduced vision on visuomotor performance. Participants completed a variety of tasks (water-pouring, pegboard, aiming) and measures of visual acuity, contrast sensitivity and stereopsis were recorded as before for each visual condition. The findings provided support for the benefits of second-eye surgery (stereopsis and contrast sensitivity improved from monocular cataract to the no filter condition, and there was a trend for water-pouring), but this was not the case across all tasks. Further research should focus on exploring exactly which tasks are detrimentally affected by removing only one cataract, and the practical implications

of this for daily life, to foster principled investigations of the health economics of cataract surgery.

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Status of refractive errors and binocular vision anomalies in new immigrants with residence permit in Kongsberg, Norway

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Abstract

Good vision is important for learning (Helsedirektoratet, 2017; Lambert & Lyons, 2017; Simons & Gassler, 1988; Williams, Latif, Hannington, & Watkins, 2005) and may have particular importance when learning a new language. Good language skills are a prerequisite for successful integration (Garzia, 1996). New immigrants and refugees granted residence permits in Norway must participate in an extensive course in Norwegian language and social studies (likestillings- og inkluderingsdepartementet, 2012), but they are not systematically offered an eye examination, and the extent of their visual problems is unknown. The purpose of this study was to find the magnitude of refractive errors and binocular vision anomalies among a group of new immigrants with residence permit attending the Norwegian course.

All the 98 adults enrolled in 7 classes at Kongsberg Norwegian centre were invited, and 75 of these participated (76.5%, 18-63 years (31.7 ± 9.8 years), 58.7% male, 18 nationalities). The simplified optometric examination consisted of a short symptoms questionnaire, habitual logMAR visual acuity distance/near (VA), cover test distance/near, near point of convergence (NPC), accommodation amplitude, stereo acuity, non-cycloplegic static retinoscopy and cycloplegic autorefraction (Huvitz, HRK8000A). Assessment of ocular health, colour vision, pupillary reflexes, ocular motility and peripheral visual field test were also part of the protocol.

Habitual binocular VA was -0.11 ± 0.13 (mean \pm SD) at distance and -0.06 ± 0.12 at near, and VA poorer than or equal to 0.10 at distance and near was found in 6.7% and 16% of the participants, respectively. Cycloplegic autorefraction showed that 14.1% had myopia (SER < -0.5 DS), 35.9% emmetropia (≥ -0.50 D and $\leq +0.50$ D), and 50.0% hyperopia (SER > 0.5 DS). 20.3% had astigmatism (≤ -0.75 DC) and 4.7% anisometropia (≥ 1.00 DS). 58.7% had accommodative or binocular anomalies based on criteria from literature, and most prevalent were poor accommodation, reduced stereo acuity and reduced NPC. The likelihood of the participants receiving an intervention increased with increasing score on the symptoms questionnaire. 49.3% (33) of the participants were referred to the vision clinic. Of these, 27.2% and 39.3% were prescribed spectacles for distance and near, respectively, and 9% were given vision therapy. Two (6%) did not need treatment, and one (2.7%) was referred to an ophthalmologist. One-third (31.3%) of the participants had a

spectacle correction, but only half of these corrections were adequate.

The true prevalence of vision problems in this group cannot be estimated as there may be bias towards people having problems participating. Even so, the results show that almost half of the participants had a vision problem that could interfere with their ability to learn a new language, but which could easily be managed.

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Using a Tailored Lighting Intervention to Improve the Lives of People Living with Dementia and their Caregivers

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Abstract

By 2050, it is estimated that the global population of older persons (65+ years) will reach about 1.5 trillion, which represents a 150 percent increase from 2015 and stands in sharp contrast to the essentially flat population growth expected for those 20 years and younger over the same period (He, Goodkind, & Kowal, 2016). Dementia is a progressive, degenerative disease of the brain whose strongest risk factor is age. There is no known cure, and there are very few effective treatments. An estimated 46.8 million people were living with dementia worldwide in 2015, and that number is expected to nearly triple by 2050 (Prince, Comas-Herrera, Knapp, Guerchet, & Karagiannidou, 2016). The estimated global cost of caring for people with dementia is expected to reach US1 trillion by 2018 (Prince et al., 2016).

Alzheimer's disease and related dementias (ADRD) are associated with sleep disruption, depression, agitated behaviours, cognitive problems, diminished physical mobility, and caregiver burden, all of which can profoundly impact patient and caregiver quality of life and lead to patients' institutionalisation. In respect to sleep, people with ADRD suffer from severe dysfunction of their sleep-wake and circadian systems, which manifests clinically as sundowning (increased night-time confusion, anxiety, agitation, pacing, wandering, and disorientation that begins at dusk), excessive daytime sleepiness, daytime agitation, and day-night reversal

(Ancoli-Israel et al., 1997; Bliwise, Carroll, Lee, Nekich, & Dement, 1993). Sleep is critical for healthy cognitive processing, and poor sleep can further compromise cognitive functioning and increase behavioural problems in those with ADRD.

Light therapy for older adults with ADRD has been found to improve measures of circadian entrainment and sleep (Ancoli-Israel et al., 2003; Dowling, Hubbard, et al., 2005; Dowling, Mastick, Luxenberg, & Burr, 2005; Satlin, Volicer, Ross, Herz, & Campbell, 1992; Sloane et al., 2007; Van Someren, Kessler, Mirmirann, & Swaab, 1997; Yamadera, Takahashi, & Okawa, 1996), decrease sundowning symptoms and agitated behaviours (Lyketosos, Lindell Veiel, Baker, & Steele, 1999; Satlin et al., 1992), and relieve depressive symptoms (Hickman et al., 2007). The Lighting Research Center (LRC) at Rensselaer Polytechnic Institute has been investigating the comparative effectiveness of a short-term (i.e., 4 weeks) tailored lighting intervention for improving sleep and behaviour in people with ADRD and their caregivers living at home (Figueiro et al., 2015) and those with ADRD living in nursing homes and assisted living facilities (Figueiro et al., 2014). We are currently investigating the comparative effectiveness of both short-term (4 weeks) and long-term (6 months) exposure to the same lighting intervention among people with moderate or late-stage ADRD living in nursing homes.

The presentation will begin with a broad discussion of the human circadian system and light's role in maintaining circadian rhythms, paying particular attention to circadian phototransduction (i.e., the process whereby light received at the eye is converted to electrical stimulus in the brain). The current state of research in the field will be discussed, and the results of the LRC's studies will be summarised in detail. The presentation will conclude with a discussion of what remains unknown in the field of lighting for the circadian system, and what may be expected in future research and applications for improving the lives of people with ADRD, their caregivers, and the greater community.

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Light and ageing

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Abstract

Light is a prerequisite for vision, and lighting is a significant environmental attribute to promote visual, physical and mental health. Older persons need more light to compensate for reduced vision due to normal age-related changes, particularly due to reduced pupil size and a cloudy intraocular lens. Reduced vision increases risks of falls, depression and anxiety. Further, vision loss negatively affects general health and both basic activities of daily living (ADLs) (dressing, transferring) and instrumental activities of daily living (IADLs) (food preparation, reading). Poor lighting exacerbates these problems. The population of older persons is increasing, which means that more people will require health care. Good vision and lighting may result in both improved quality of life, health and significant social economic effects. Consequently, assessing the home environment is an important task in enabling older people to stay at home. The talk will present results from a two-part intervention study with the aims to measure lighting levels in the homes of healthy 75-year-olds and how they, in respect to the indoor lighting, assess their vision and general health, ADLs and IADLs, and well-being. Further, to investigate how improved lighting affected abilities to perform IADLs and health related quality of life in

older people living at home. In the baseline study 114 75-year-olds living at home participated with informed consent. Indoor lighting levels were measured in several rooms. Based on the measured lighting levels in the baseline study, 60 participants were stratified to the intervention group (IG = 30) or control group (CG = 30) in the lighting intervention which optimised lighting in the living room. Self-reported visual and general health and ability to perform ADLs and IADLs with regards to ambient lighting levels were recorded using a questionnaire using visual analogue scales and SF-36. Good vision is essential in maintaining healthy ageing at home and requires adequate lighting. However, the knowledge and awareness of this is limited. The intervention showed that improved lighting can easily be achieved with a basic lighting control system. This suggests that improved quality of light can improve quality of life. Some of this work has been previously published (Eilersten, Horgen, Kvikstad, & Falkenberg, 2016) or presented.

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Lighting Design for Low Vision

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Abstract

As we age, so do our eyes. Typically, an old eye is more sensitive to glare and high contrast, has slower dark adaptation, reduced accommodation, and may have some other vision changes. Older adults also experience a shift in colour perception and a yellow cast that can, in some individuals, completely alter their ability to read the colour accuracy of objects. Persons who are 65 years or older may need four times the amount of light or more to complete the same task as a 25-year-old adult. Besides ageing, certain diseases (such as diabetes, Alzheimer's, dementia and some other eye-related diseases) may change visual requirements even in younger population groups, which requires even better lighting design considerations.

But proper illumination adequate for ageing sight changes or low vision is often not a focus of discussions in lighting design communities. It should be because current lighting regulations are established based on empirical data obtained from young subjects. Additionally, a growing sustainability and energy efficiency policy has resulted in even more reduced illuminance requirements for the same visual tasks in global regulations and codes (CIE 227: 2017).

It is also widely assumed that lighting for elderly people or lighting for low vision is relevant for hospital buildings, nursing homes or residential buildings. However, while lighting should be rigorously considered and planned for hospitals and homes for the elderly, it is not limited only to these building types.

Seniors represent the fastest growing segment of the population. Due to modern demographic change, the labour market requires more elderly people to work, while ageing is ac-

accompanied by a decrease in cognitive abilities and in the capabilities of the visual system from the age of 50 onwards. Statistical data shows that the percentage of working adults of ages from 50 to 74 years old in Norway is equal to 30.3% of the whole working population. This is a significant part of the society that works under reduced visual comfort (for their age group). Therefore, proper lighting design for low vision is equally important in offices and other workplaces.

So, what should lighting designers consider in order to provide illumination suitable for low vision?

First, lighting design for low vision should not be limited to luminaire and control system choice only, but also daylighting, and interior design consideration, as well as non-visual effects of lighting. Examples and recommendations for practical lighting solutions for older people and people with low vision will be discussed in the presentation.

Under a well-designed lighting setting, tasks can be performed easily, the desired mood can be set, well-being may be increased, and users can live/work and communicate with the surrounding world safely (Kunduraci, 2017). Lighting design should be person-centred and naturally integrated into architecture, supporting users with low vision during their daily lives, minimising any challenges, providing a healthy visual environment, circadian rhythms support, and sleep efficiency.

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Two types of glare – two visual channels

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Abstract

Two types of glare are recognised in the lighting industry (Rea, 2000): disability glare, which affects on-axis contrast sensitivity; and discomfort glare, which evokes photophobic responses. Quantification of disability glare is well established (Fry, 1954) and predictive algorithms are successfully used to calculate target visibility under actual lighting conditions, particularly those associated with night-time driving. Disability glare is the result of scattered light in the eye that produces a luminous veil on targets presented to the fovea and on their immediate backgrounds, reducing the targets' apparent contrast. In terms of spectral sensitivity, the photopic luminous efficiency function based upon the L- and M-cone responses accurately characterises the veiling luminance for any coloured glare source (Bullough, Fu, & Van Derlofske, 2002; Steen, Whitaker, Elliott, & Wild, 1993). Quantification of discomfort glare has been more elusive. Discomfort glare is the result of neural channels apparently associated with brightness perception (Rea, Radetsky, & Bullough, 2011). The S-cone response is particularly important to the spectral sensitivity of discomfort glare (Bullough, 2009). For example, red and blue glare sources of the same photopic intensity will produce similar levels of disability glare, but the blue light will be seen as having significantly greater

discomfort glare. Formulae for determining disability and discomfort glare will be presented together with results from psychophysical studies aimed at understanding their underlying neurophysiology.

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