BOOK OF ABSTRACTS

Riga, Latvia, October 6 – 8, 2016

1st International Symposium on Visual Physiology, Environment, and Perception

Dear colleagues and friends,
Welcome to the 1st International symposium on visual physiology, environment, and perception in Riga!

This Symposium is a collaborative project of scientists from three Baltic countries – Latvia, Lithuania, and Estonia to make vision science more recognizable in Baltic region. We also have invited one additional country – this year it is Germany – to join our organizing group specially promoting vision science work in their country.

The Symposium will take place in **Riga, Latvia, on 6^{th} -8^{th} October 2016**.

Hosting institution: Department of Optometry and Vision Science, University of Latvia.

We welcome participants from any country involved in various fields of vision science. The main aim of this Symposium is to promote cooperation and communication between researchers and research fields, as well as exchange of information on the state-of-the-art of research and equipment in various topics of vision science:

- Visual physiology (accommodation, binocular eye movements, pupil physiology);
- Environment (lighting, visual fatigue, technology of visual stimuli);
- Visual perception (visual attention, colour perception, spatial vision);
- Clinical studies (clinical studies in optometry – clinical cases, diagnostics, and treatment).

We hope this Symposium will serve as a place where to meet new friends and collaborators, and will lead to a new tradition – to gather scientists once in two years and with changing location between three Baltic countries and with changing invited country.

The organizing committee,

Dr. Phys.
Aiga Švede
Riga, Latvia

Prof. habil. dr.
Aleksandr Bulatov
Kaunas, Lithuania

Prof.
Jüri Allik
Tartu, Estonia

Dr. Ing.
Wolfgang Jaschinski
Dortmund, Germany

	Thursday, 6 October, 2016			Friday, 7 October, 2016			Saturday, 8 October, 2016			
	Hall (ground floor)	Magnum auditorium	Hall (first floor)	Magnum auditorium	Room 107	Room 108	Magnum auditorium	Room 107	Room 108	Restaurant Klīversala
9:00-9:30				Session 1 (Illusions & environment)			Session 3 (Binocularity)			
9:30-10:00										
10:00-10:30										
10:30-11:00										
11:00-11:30					Coffee break	Demonstration		Coffee break	Demonstration	
11:30-12:00				Keynote lecture			Keynote lecture			
12:00-12:30										
12:30-13:00					Lunch			Lunch		
13:00-13:30										
13:30-14:00				Poster session presentations			Poster session presentations			
14:00-14:30					Posters and coffee break	Demonstration		Posters and coffee break	Demonstration	
14:30-15:00										
15:00-15:30										
15:30-16:00				Session 2 (Learning & visual perception)			Session 4 (Clinical)			
16:00-16:30	Registration									
16:30-17:00										
17:00-17:30										
17:30-18:00										
18:00-18:30		Opening								
18:30-19:00		Keynote lecture								
19:00-19:30										Closing dinner
19:30-20:00			Welcome reception							
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21:30-22:00										

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ORGANIZING COMMITTEE

Dr. Phys. Aiga Švede,
Department of Optometry and Vision Science, Faculty of Physics and Mathematics, University of Latvia, Riga, Latvia.

The University of Latvia is the oldest institution in the Baltic countries and the only university that confers academic and professional degrees in optometry. Optometry study programs in the University of Latvia were introduced in 1992 in the Faculty of Physics and Mathematics. However, an independent Department of Optometry and Vision science was founded in 1996. Since 1998, the studies of optometry are organized in three levels – Bachelor, Master (professional and academic), and Doctoral studies – and have positive experience with international groups (from Italy, Sweden, and Estonia) both in Bachelor and Master study programs organizing the studies not only in Latvian, but also in English and Russian. Both students and researchers of the department are involved in different studies with main research fields in eye movements, accommodation and vergence studies, colour vision, binocular vision and stereovision, visual perception, visual blur, child vision development and screening possibilities, physiological and adaptive optics, and cognitive science.

LATVIJAS UNIVERSITATE ANNO 1919
UNIVERSITY OF LATVIA

Prof. habil. dr. Aleksandr Bulatov,
Head of Laboratory of Neurophysiology of Vision, Lithuanian University of Health Sciences, Institute of Biological Systems and Genetics Research, Kaunas, Lithuania.

In the Laboratory of Neurophysiology of Vision, the studies of visual perception have been developed over 50 years. The Laboratory's scientists have analyzed the structure and principles of functioning of the receptive fields of separate neurons as well as their networks at different levels of the visual system; explored the effects of colour constancy; investigated the regularities of the visual field anisotropy. During the recent 20 years, the Laboratory's scientists concentrated mainly on issues concerning the peculiarities of the visual perception of size, shape, orthogonality, and curvature. The important part of the current scientific activity is mathematical modelling of the geometrical illusions of extent, with aim to understand neural mechanisms of the visual object localization.

LITHUANIAN UNIVERSITY
OF HEALTH SCIENCES

Prof. Jüri Allik,
Head of Department of Experimental Psychology, University of Tartu, Tartu, Estonia.

Since reopening of University of Tartu in 1802, psychology is taught without significant interruptions as an independent subject. The main studies are related to human perception and behaviour including vision, automatic change detection (i.e., mismatch negativity, led by professor Risto Näätänen) in audition and vision, affective perception and its relations to personality, behavioural impulsivity, cognitive abilities etc. with psychophysical and psychophysiological (e.g., EEG and fNIRS) methods. In the Institute of Psychology, scientists from the department teach experimental psychology and its methodology, cognitive psychology and related disciplines. The department is characterized as being creative, dynamic, open to ideas, and very collaborative.

UNIVERSITY OF TARTU
FACULTY OF SOCIAL SCIENCES AND EDUCATION
Institute of Psychology

Dr. Ing. Wolfgang Jaschinski,
Head of the research group „Individual Visual Performance", The Leibniz Research Centre for Working Environment and Human Factors (IfADo), Dortmund, Germany.

The Leibniz Research Centre for Working Environment and Human Factors (IfADo) investigates potentials and risks of modern work on the basis of behavioural and life sciences. The results lead to principles of beneficial and healthy design of the working environment. The IfADo is a cross-disciplinary institute for integrated applied and basic research related to occupational health and human performance. Its research groups combine different academic subjects such as ergonomics, psychology, toxicology, and occupational medicine/biology. This spectrum of scientific competences is a unique feature of the IfADo. The research group „Individual Visual Performance" had many research topics evaluating (1) finding new solution for visual and musculo-skeletal complaints of presbyopes working at the computer by combining ergonomic and optometric knowledge and research; (2) examining vergence movements using nonius lines and video eye-tracking methods; (3) evaluating binocular coordination in reading and in visual strain.

IfADo
LEIBNIZ RESEARCH CENTRE
FOR WORKING ENVIRONMENT
AND HUMAN FACTORS

ORGANIZING STAFF

Prof., Dr.phys. **Gunta Krūmiņa**, Head of the Department of Optometry and Vision Science, optometrist, senior researcher; Dr.Phys. **Sergejs Fomins**, Docent, senior researcher; Dr.Phys. **Gatis Ikaunieks**, Docent, researcher; Dr.Phys. **Kaiva Juraševska**, Optometrist, lecturer; Dr.Phys. **Evita Kassaliete**, Optometrist, lecturer; MSc. **Ilze Laicāne**, Optometrist, PhD student; MSc. **Karola Panke**, Optometrist, PhD student; MSc. **Anete Paušus**, Optometrist, PhD student; Dr.Phys. **Ieva Timrote**, Optometrist, lecturer; MSc. **Renārs Trukša**, Optometrist, PhD student;

1st International symposium on visual physiology, environment, and perception (VisPEP2016)

FULL PROGRAMME

Thursday, 6 October, 2016			
Room 701			
		15:00-17:00	Meeting of the organizers
Hall (ground floor)			
16:00-18:00	Registration		
Auditorium Magnum			
18:00-18:05	Opening words from the organizers		
18:05-18:10	Opening words from the prof. Indriķis Muižnieks – rector of the University of Latvia		
18:10-18:20	Opening words from Ģirts Cimermans, Executive Officer of HOYA Corporation		
18:20-18:30	Opening words from Ieva Pranka – Executive Director of the Baltic-German University Liaison Office		
18:30-19:30	Keynote lecture*: **Visual Phenomena & Optical Illusions** (Michael Bach)		
Hall (first floor)			
19:30-22:00	Welcome reception		

Friday, 7 October, 2016	
Auditorium Magnum	
Session 1: Illusions and environment (S.Fomins, K.Juraševska,)	
9:00-9:20	**The aftereffects of Müller-Lyer and Ponzo illusions in sensorimotor domain** (V.Lyakhovetskii, V.Karpinskaia)
9:20-9:40	**Modelling foveated vision in Matlab image processing** (W.B.Kloke)
9:40-10:00	**Motion induced blindness using increments and decrements** (W.W.Stine, P.A.Levesque, M.E.Lusignan, A.J.Kitt)
10:00-10:20	**Range of comfortable brightness for self-luminous surfaces in architectural applications** (M.Reisinger)
10:20-10:40	**Study of volumetric image depth perception for observing generic volumetric scenes** (K.Osmanis, I.Osmanis, G.Valters, M.Narels)
10:40-11:00	Discussion
Room 107	
11:00-11:30	Coffee break
Room 108	
11:00-11:30	**Demonstration of True Volumetric 3D display (Lightspace Technologies)**
Auditorium Magnum	
11:30-12:30	Keynote lecture*: **Visual acuity and contrast thresholds – Not trivial to measure** (Michael Bach)
Room 107	
12:30-13:30	Lunch
Auditorium Magnum	
Poster session 1 (2 min presentations) (S.Fomins)	
13:30-14:00	**Influence of filling discontinuity on the strength of illusion of perceived length** (A.Bielevičius, T.Surkys, A.Bertulis, A.Bulatov) **P1-1**

	Dependende of filled/unfilled illusion magnitude on the completeness of filling (T.Surkys, A.Bulatov, L.Mickienė, I.Daugirdaitė) **P1-2**
	Oppel-Kundt illusion magnitude changes evoked by the tilting of the filling element (A.Bulatov, T.Surkys, N.Bulatova, P.Šimaitytė) **P1-3**
	Superposition of differing structures in the Oppel-Kundt stimuli (A.Bertulis, T.Surkys, A.Bulatov, J.Loginovič) **P1-4**
	Illusory depth sense of colour images in "Virtual Reality" adapters using mobile phone (K.Muižniece, M.Ozoliņš) **P1-5**
	Chromatic sensitivity evaluation with static and dynamic color vision stimuli (R.Trukša, K.Juraševska, A.Livzāne) **P1-6**
	Metameric light sources: a recent paradigm for functional lighting* (A.Petrulis, P.Vitta, R.Vaicekauskas) **P1-7**
	Colorimetric and circadian light characteristics of Latvian sky (S.Fomins, M.Ozoliņš) **P1-8**
	Optical system with dynamic magnification (M.Sobczak, A.Popiołek-Masajada) **P1-9**
	Influence of object size on recognition time in mental rotation test (L.Zariņa, J.Šķilters, V.Lyakhovetskii, G.Krūmiņa) **P1-10**
	Visual search depending on the set size and number of targets (I.Timrote, A.Anča , P.Vendiņa, B.Griķe, I.Cehanoviča, V.Lyakhovetskii) **P1-11**
	Perceptual grouping in central and peripheral visual field (I.Laicāne, J.Šķilters, V.Lyakhovetskii, A.Kūlīte, G.Krūmiņa) **P1-12**
	The effect of emotional arousal environment on first graders reading (A.S.Alekseeva, O.V.Lomtatidze, L.V.Zagumennova) **P1-13**
Room 107	
14:00-15:30	**Posters** and Coffee break
Room 108	
14:00-15:30	**Demonstration of True Volumetric 3D display (Lightspace Technologies)**
Auditorium Magnum	
Session 2: Learning and visual perception (J.Allik, I.Timrote)	
15:30-15:50	**Accommodation amplitude in school-age children** (G.Ikaunieks, M.Segliņa, K.Panke, G.Krūmiņa)
15:50-16:10	**Does binocular instability affect reaction times and procedural motor learning in developmental dyslexia?** (A.Brenk-Krakowska, A.Przekoracka-Krawczyk, P.Nawrot, P.Rusiak, R.Naskręcki)
16:10-16:30	**Interviewing children with reading difficulties about environmental factors influencing their reading performance*** (S.Breitenbach)
16:30-16:50	**Parameters affecting coherent motion perception** (E.Kassaliete, R.Trukša, A.Krastiņa, A.Petrova, I.Lācis)
16:50-17:10	**Effects of mental fatigue on visual grouping** (T.Pladere, D.Bete, J.Šķilters, G.Krūmiņa)
17:10-17:30	Discussion

Saturday, 8 October, 2016	
Auditorium Magnum	
Session 3: Binocularity (W.Jaschinski, I.Laicāne)	
9:00-9:30	**Review of fixation disparity: methods, findings, concepts** (W.Jaschinski)
9:30-10:00	**A new approach to fixation disparity: determining aligning prisms without using trial prism lenses** (O.Prenat)
10:00-10:20	**Effect of vision therapy on vergence response in accommodation and vergence problems** (I.Siliņa, A.Švede)
10:20-10:40	**Examining crowding using a real three-dimensional experimental setup*** (L.V.Eberhardt, A.Huckauf)
10:40-11:00	Discussion
Room 107	
11:00-11:30	Coffee break
Room 108	
11:00-11:30	**Demonstration of Hoya EyeGenius**
Auditorium Magnum	
11:30-12:30	Keynote lecture*: **Binocular coordination and binocular advantages in reading** (Stephanie Jainta)
Room 107	
12:30-13:30	Lunch
Auditorium Magnum	
Poster session 2 (2 min presentations) (A.Švede)	
13:30-14:00	**Open-view system for measurements of accommodation and vergence** (A.Švede, M.Sobczak, K.Panke, S.Fomins, R.Trukša, G.Krūmiņa) **P2-1**
	Binocular coordination in reading when changing background brightness (A.Köpsel, A.Huckauf) **P2-2**
	Differences in cortical activation between pure volitional saccades and pure volitional vergences (M.Wojtczak-Kwaśniewska, A.Przekoracka-Krawczyk, R.van der Lubbe) **P2-3**
	The time course of adaptation depending on subject's refraction (A.Petrova, E.Eldmane, P.Cikmačs) **P2-4**
	Optimal optotype structure for monitoring visual acuity (G.Rozhkova, D.Lebedev, M.Gracheva, S.Rychkova) **P2-5**
	Mobile devices for studies of binocular summation of colour stimuli (V.Zavjalova, M.Ozoliņš, O.Daņiļenko) **P2-6**
	Interactive computer trainings for improvement of binocular functions (M.Gracheva, S.Rychkova, I.Senko, H.P.Tahchidi) **P2-7**
	Computer-aided techniques in analysis and treatment of strabismic suppression: practical issues (S.Rychkova, M.Gracheva, I.Senko) **P2-8**
	Visual acuity and contrast sensitivity in different keratoconus stages (S.Līduma, G.Krūmiņa) **P2-9**
	Vertical zones of clear vision with progressive addition lenses (M.König, W.Jaschinski) **P2-10**
	Assesment of iridocorneal angle (A.Keiša) **P2-11**
Room 107	
14:00-15:30	**Posters** and Coffee break
Room 108	
14:00-15:30	**Demonstration of Hoya EyeGenius**

Auditorium Magnum	
Session 4: Clinical (G.Krūmiņa, G.Ikaunieks)	
15:30-15:50	**Differences in the development of deprivational and disbinocular amblyopia** (S.Alekseenko, P.Shkorbatova)
15:50-16:10	**Current trends of myopia management strategies in clinical practice** (M.Zvirgzdiņa, J.B.Orr, N.S.Logan, J.S.Wolffsohn)
16:10-16:30	**Orthokeratology and short term changes in peripheral refraction** (A.Hartwig, H.Radhakrishnan)
16:30-16:50	**Corneal curvature changes using long term orthokeratology*** (L.Kozuliņa, G.Krūmiņa)
16:50-17:10	**Slope of the accommodative response measured with the retinal brightness method** (V.Karitāns, N.Fridrihsone, E.Kassaliete, A.Švede, M.Ozoliņš, G.Krūmiņa)
17:10-17:30	Discussion
Auditorium Magnum	
17:30-17:40	**Conference closing**
Restaurant Klīversala, Mukusalas Str. 3	
19:00-22:00	Closing dinner

* Supported by the Baltic-German University Liaison Office. The project of the Baltic-German University Liaison Office is supported by the German Academic Exchange Service (DAAD) with funds from the Foreign Office of the Federal Republic Germany.

Minor changes to the programme can occur until the start of the Symposium. We will keep the programme on our website (www.vispep.lu.lv) up to date at all times. Please check back regularly our website (www.vispep.lu.lv) to download the most recent versions of the programme.

USEFUL INFORMATION

Registration and on-site payment

You can register for the VisPEP on Thursday 6th October from 4pm to 6pm at the Academic Center for Natural Sciences of University of Latvia, on the ground floor (near the Magnum Auditorium). Please follow the directions.

At the registration you will receive the conference bag containing conference materials. It is very important that you wear your conference badge to access all the conference events.

All participants must pay the registration fee. If you submit the abstract, author and co-authors need to register and pay registration fee if they are planning to participate in the symposium.

The registration fee includes admission to all scientific sessions, access to exhibition and poster area, certificate of attendance, free conference materials, admission to the welcome reception (October 6), two lunches (October 7-8), coffee/tea/water and snacks during the coffee breaks.

Early registration fee 110 EUR (students* 60 EUR including Bachelor, Master, and PhD students)
Late registration fee 160 EUR (students* 100 EUR including Bachelor, Master, and PhD students)
Accompanying person** fee 35 EUR
Industry place 250 EUR

* Students must present a valid student ID card at the registration desk.

**Accompanying person accompanies the participants at the conference. Accompanying person do not follow the scientific programme of the conference. The registration fee of accompanying person includes admission to the welcome reception (October 6), two free lunches (October 7-8), coffee/tea/water and snacks during the coffee breaks.

If you have not paid the conference fees in advance, you must present your payment order at the registration desk. Please note that payment by debit/credit card and/or cash WILL NOT be available. We'll accept bank transfers only. Alternatively, you can make a transaction in a bank. Our bank details can be found at our website after login: http://www.vispep.lu.lv/registration/payment-instructions/

If you need to leave your luggage in a safe room, please contact the registration desk.

Name badge
It is very important that you wear your conference badge to access all the conference events. There will be different name badge colours:

Participants, Exhibitors	Organizers	Invited Speakers	Accompanying person

Internet access/Wi-Fi
Free Wi-Fi access will be available throughout the conference venue. Login and password is written on the opposite side of your name badge.

Coffee breaks and lunch
Two coffee breaks and one lunch break will be provided on Friday and Saturday in room 107 (**you will be able to enter the room ONLY with your name badge**). In the meantime, there is a cafe next to the library (located on the ground floor), and area where to get snacks and coffee (located on the first floor just above the main entrance).

Welcome reception
In order to participate in the Welcome reception, you should wear your name badge.

Closing Dinner
If you have paid for the Closing Dinner at National Library of Latvia, restaurant Klīversala, you will receive a ticket at the registration. The dress code is smart casual.
For more information about this event, see section Venues.

Demonstration
During the Coffee break (11:00-11:30 and 14:00-15:30), we will provide demonstrations in Room 108. On Friday, Lightspace Technologies will have a Demonstration of True Volumetric 3D display. On Saturday, Hoya will have a demonstration of EyeGenius.

Technical information for Talks
There will be four sessions – each 2 hours long and consisting of 4-5 talks. Each talk will be 20 minutes long. Discussion is organized at the end of the session after all the talks.
A computer for presentations supporting PPT, PPTX and PDF formats will be provided. Participants should upload their presentation before their session. Participants that use their own computers, should test the connection (VGA, HDMI) to projector in advance. We recommend testing the presentation in the morning or during the break before the session.

In case of technical problems, there will be somebody from organizers ready to help with the technical issues of connecting the media.

Technical information for Posters
Before each poster session, there will be short presentations of the posters. The participants are expected to prepare a short (up to 2 minutes) power-point presentation highlighting the main idea and findings of their study. The sequence of the short presentations is indicated in the programme. A computer for presentations supporting

PPT, PPTX and PDF formats will be provided. The use of own computers for the short presentations is not allowed. The participants should upload their presentation before their session. We recommend testing the presentation in the morning or during the break before the session.
The poster board dimensions will be 905 cm width x 1950 cm height (portrait orientation). A0 size portrait or A1 landscape is recommended. Materials will be provided to hang the posters on the poster walls.

Each poster has been given a unique poster number and must be mounted on the appropriately numbered board. The posters are being divided in two groups based on this number – P1 for Friday, and P2 for Saturday. You can check the number by referring to the full programme.

Participants have to put their posters up by 11:00 on October 7 and posters will be displayed throughout the duration of the Symposium (until 17:30 on October 8). Authors are expected to be present at their posters during their poster session.

Copying and printing
Large format printing in Riga:

COPYPRO, Raina blvd. 17; working hours Mon-Sun 0:00-24:00; Mukusalas str. 41B/4, entrance 4A; working hours Mon-Fri 8:00-19:00.

MERKELA DRUKA , Merkela str. 13, working hours Mon-Fri 08:00-21:00, Sat-Sun 09:00-18:00.

Regular printing can be done at the Natural Sciences library (UL Academic Centre of Natural Sciences) from 10:00 to 18:00 on working days, and 9:00-17:00 on Saturday. Please contact the librarian for more information.

Small number of items might be printed at the registration desk.

Student competition
Five best student’s abstracts will be awarded – four students (Latvia, Lithuania, Estonia, Germany) will have full support (accommodation, travel, registration fee, and closing dinner) and one student (from other countries) will have partial support (at the moment - no registration fee and invitation to closing dinner).

The winners of the Student's competition are: S. Breitenbach L. V. Eberhardt, L. Kozulina, and A. Petrulis. Congratulations!

Open access publication in Proceedings of the Journal of Latvian Academy of Sciences. Section B. Natural, Exact, and Applied Sciences (Scopus) will be provided for best abstracts.

Videoconference
Videoconference will be available using individual password as an option for those, not having possibility to travel to Latvia but wanting to listen to lectures and oral presentations. The registration fee for the videoconference includes possibility to watch all scientific sessions, free conference materials, and certificate of attendance.

Insurance and emergency

The conference organizers and the conference venues shall not be held liable for personal injury or any loss or damaging to the belongings of the conference participants, either during or as a result of the conference. Please check the validity of your own insurance.

In emergency dial 112 to contact the police, fire or ambulance service.

If you need an advice on common health problems which would not require emergency medical assistance, dial 66016001 (Family Physicians Advisory phone).

Sightseeing proposals

http://www.inyourpocket.com/riga/sightseeing
https://www.liveriga.com/en/2-vietas

Closest Riga Tourist information Centre (TIC) is located in Old Town – on Town Hall Square. They provide consultations, informative materials, guided tour tickets, etc.

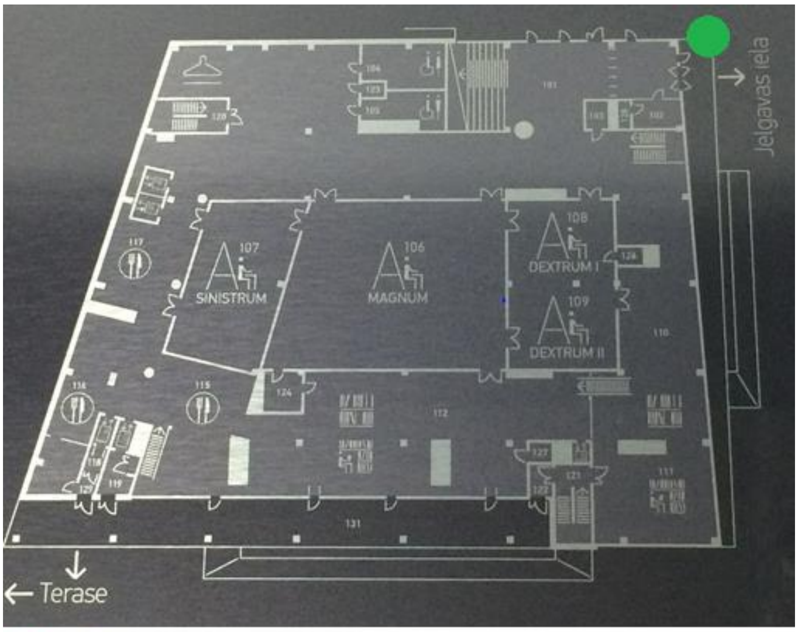
THE VENUE

Academic Center for Natural Sciences

Address: Jelgavas iela 1, Riga, LV-1004, Latvia

The conference will be held at Academic Center for Natural Sciences of the University of Latvia (LU Dabaszinātņu Akadēmiskais Centrs, abbreviated as DAC) is the first building of the developing campus of University of Latvia. It was built in 2015, and is located on the left bank of river Daugava, not far from the Old Town. Faculties of Biology, Chemistry, Geography and Earth Sciences, Medicine (pharmacology and biochemistry study programs), as well as Department of Optometry and Vision Science of the Faculty of Physics and Mathematics are located in this building.

For information how to get to the venue, see section Public transport.



Main entrance

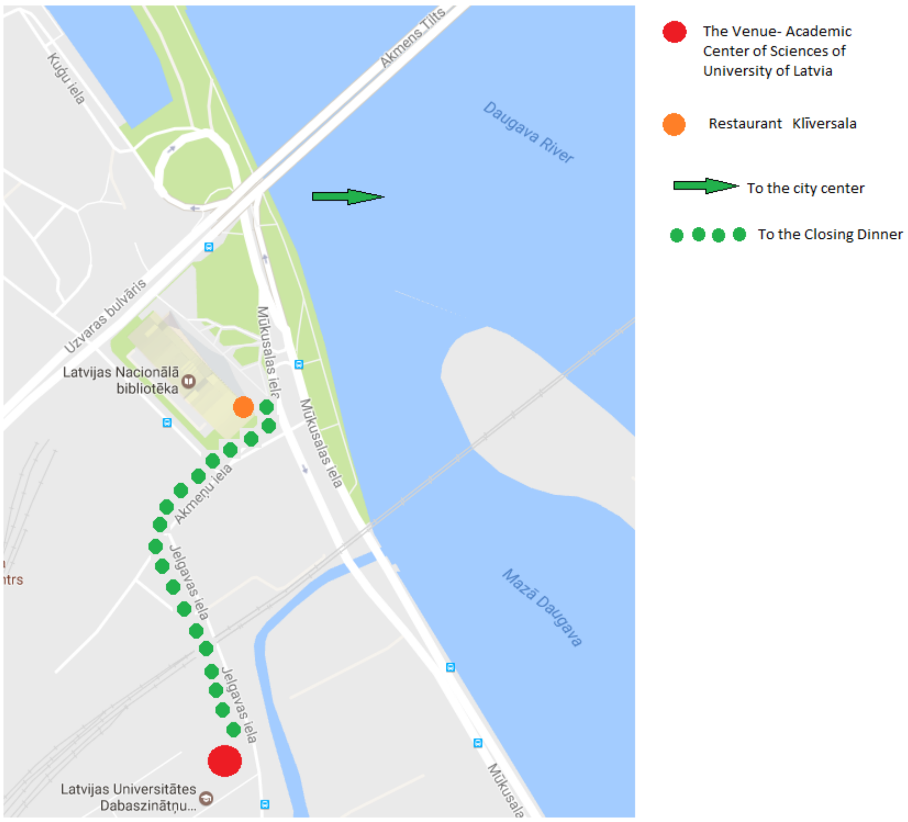
CLOSING DINNER

Restaurant Klīversala: Saturday, 8th October 19:00-22:00

Address: Mūkusalas iela 3, Riga, LV-1423, Latvia

Restaurant Klīversala is located at the Castle of Light (National Library of Latvia). The main function of the National Library of Latvia is the collection of national literature, its eternal storage and long-term access. The collection of the National Library of Latvia (4,5 million units) embraces all branches of science, its basic profile being Social Sciences and the Humanities. For more information about the restaurant, see http://www.kliversala.lv/eng/.

Entrance to the restaurant is from Mūkusalas iela (closer to the Railway bridge). Cloakroom is located to the left from the entrance.



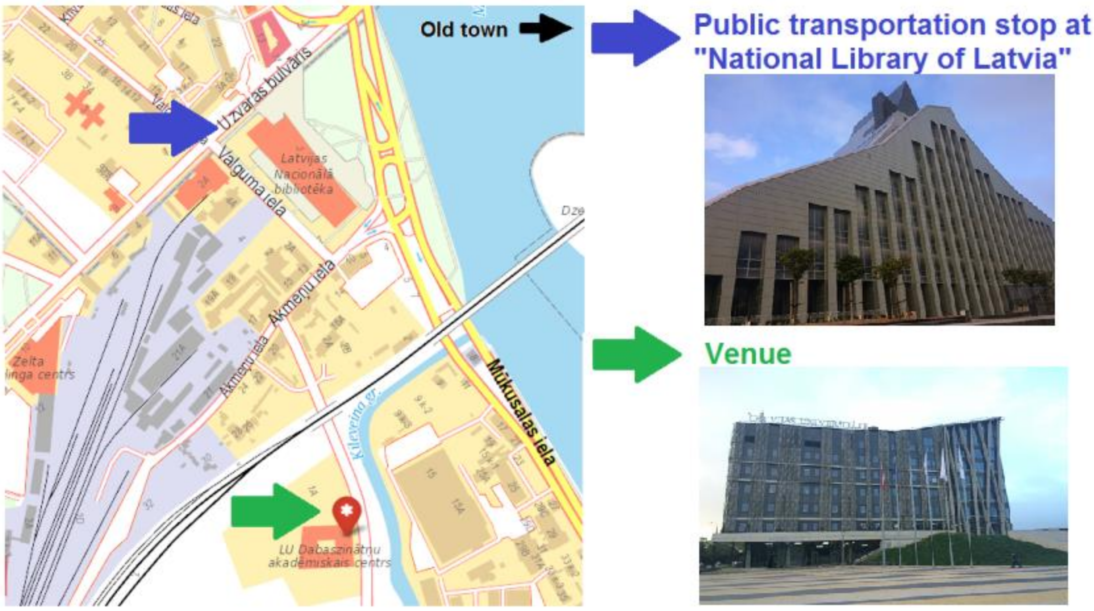
PUBLIC TRANSPORT

Traveling suggestions to the Academic Center for Natural Sciences:

All conference and events venues are within the walking distance from the city center. Walking distance from the Old Town is approximately 2 km (25 minutes at a slow pace).

Bus route No. 23 “Abrenes iela – Baloži”: bus stop “LU Akadēmiskais centrs” (located just outside the Academic Center for Natural Sciences).

Bus routes No. 3, 4, 4z, 7, 8, 21, 22, 25, 32, 35, 38, 39, 43, 54, and 55; tram lines No. 2, 4, 5, and 10: stop at “Nacionālā bibliotēka” (National Library). From there you should take a 7 minutes’ walk to the Venue.



Riga has 9 tram lines, 19 trolleybus routes, and 53 bus routes (operate from 05:00 am to 01:00 am, depending on the route).

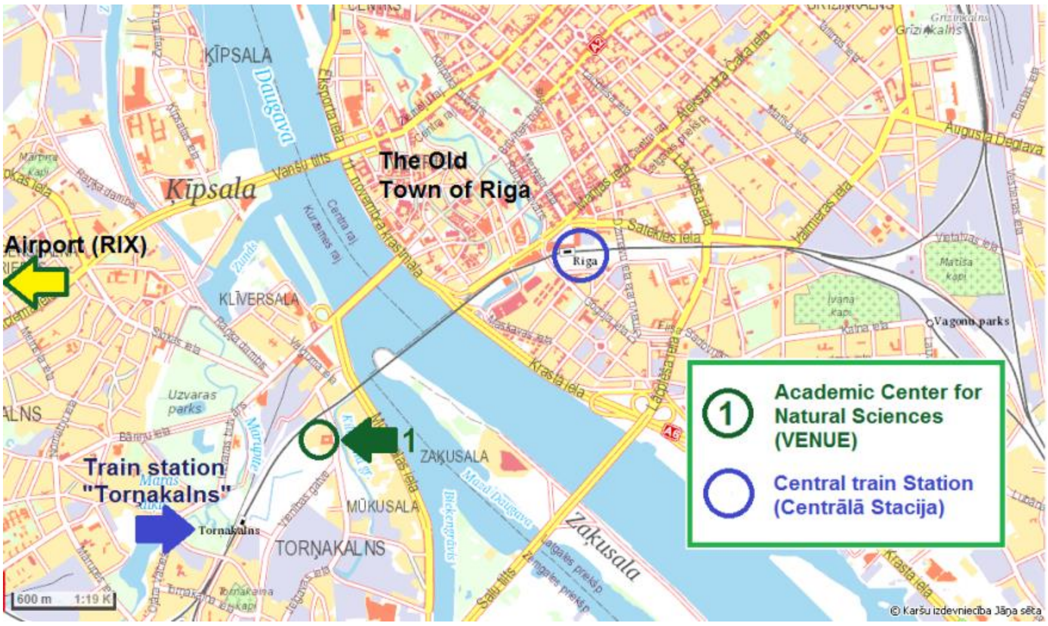
Vehicle timetables can be found at: saraksti.rigassatiksme.lv/index.html

Tickets can be bought at Riga Transport (Rīgas Satiksme) ticket offices, at public transport ticket machines or at Narvesen shops, post offices and Rimi supermarkets (€1.15 single trip). You can also buy a single-ride ticket from the driver but the cost will be higher (€2.00 single trip).

There are several ticket set options: single ride (€1.15), two rides (€2.30), four rides (€4.60), five rides (€5.75), 10 rides (€10.90), and 20 rides (€20.70). Another option is buying a ticket for one (€5.00), three (€10.00), or five (€15.00) days of travel.

The electronic tickets are valid for trams, trolleybuses and city buses. For validation you must press the ticket against the electronic ticket readers on the bus or tram as soon as you board the vehicle. If the ticket is valid, a green light will flash on and the screen and number of rides left on the card will be shown (e.g. Atlikums: 6 (six rides left)).

Trains from “Central train Station” to “Jelgava”, “Tukums” or “Sloka”. Walking distance from train station “Torņakalns” to the venue is approximately 10 minutes. Timetables can be found at: http://www.1188.lv/transport.



Alternatively, take a taxi to the venue, for example Baltic Taxi or RedCab.

GETTING TO RIGA

Arriving in Riga is fairly simple these days. The bus and train stations are located right on the edge of the Old Riga and the airport is only a short cab or bus (No 22) ride away.

By plane. Riga International Airport (RIX) offers many direct flights every day. More information can be found here:
http://www.riga-airport.com/en/main/main

By bus. There are many direct buses to Riga from Germany, Poland, Russia, Belarus, Estonia, and Lithuania. More information can be found on the Riga International Coach Terminal webpage:
http://www.autoosta.lv/about-company-2/?lang=en
http://www.autoosta.lv/?lang=en

By train. It is easy to get to Riga by train from St. Petersburg, Moscow, and Minsk. More information can be found here:
http://www.ldz.lv/en

By ferry. There is a ferry going to and from Stockholm every second day. More information about prices and timetable can be found here:
http://www.tallink.com

By private motor vehicle.
More on travel to Riga:
http://www.latvia.travel/en/city/riga-8
http://www.riga.com/travel

INVITED SPEAKERS

Michael Bach

Medical Center, University of Freiburg, Germany.

Michael Bach studied Physics, Computer Science and Psychology in Bochum and Freiburg, Germany. His PhD work at the University of Freiburg dealt with single- and multiunit neuron recordings in animal models. Over three decades he ran the Electrophysiology Clinic as Professor at the Eye Center, University of Freiburg and was President of the International Society for Clinical Electrophysiology in Vision (ISCEV) for 8 years. He is interested in all aspects of vision and has published 250+ peer-reviewed papers in various fields of human vision (h-index 49). He has authored a widely used computer-based vision test ("FrACT") and also maintains a website on Visual Phenomena and Optical Illusions (www.michaelbach.de/ot/), offering visual demonstrations and on-line experiments.

Link: https://www.uniklinik-freiburg.de/augenklinik/augenklinik/mitarbeiter/bach.html

Thursday, Keynote lecture: *Visual Phenomena & Optical Illusions.*

ABSTRACT: Our vision appears totally effortless, yet perception of images, objects, colour and motion involves complicated, ill-understood processes in our brain. We usually assume: What we see is pretty much what our eyes see and then transmit to the brain. Rather, our visual system continuously "invents" an inner world as a basis for understanding and planning, based on incomplete information. This rests on experience, both evolutionary and individually; stated more formally this is called the Bayesian interpretation of perception. When experience does not fit the current situation, ensuing missteps of our perceptual apparatus are called "optical illusions" and can reveal some of these inner mechanisms. Thus optical illusions neither "trick the eye" nor "fool the brain". The talk will present interactive demonstrations of these processes, organised along the visual dimension luminance, colour, motion, space, and gestalt.

Friday, Keynote lecture: *Visual acuity and contrast thresholds – Not trivial to measure.*

ABSTRACT: Visual acuity and contrast sensitivity are sensory thresholds and thus fall into the domain of signal detection; their value is a statistical measure weighing signal versus noise. I will cover the physiological bottlenecks of acuity and contrast thresholds. With respect to methodology, current high-resolution "retina" displays have solved the resolution problem for computerised acuity assessment. The contrast threshold is technically more challenging, and calibration of low contrast stimuli is particularly difficult; furthermore, the field is muddied by different definitions of contrast (Michelson, Weber, ratio, etc.). The problems outlined above will be demonstrated, and solutions presented that allow reliable routine measures.

Stephanie Jainta
Fachhochschule Nordwestschweiz, Hochschule für Technik, Institut für Optometrie, Olten, Switzerland.

Stephanie Jainta is currently a research fellow at Fachhochschule Nordwestschweiz, Hochschule für Technik, Institut für Optometrie in Switzerland. She started her career as a researcher at the University of Münster (Germany) where she got her PhD in Psychology. After her PhD she secured two independent research grants to spend one year as a postdoctoral research fellow at the IRIS group – CRNS in Paris (France) and another year at the School of Psychology at the University of Southampton (UK). Later she worked as a research fellow at the IfADo – Leibniz Research Centre for Working Environment and Human Factors at Dortmund, Germany. Stephanie Jainta's main research interests are suited in the field of eye movement control, focusing recently on binocular eye movements during reading. Humans typically read with two eyes but experience a stable and unitary percept of the text. In this context, the timely delivery of high quality visual information based on a fused binocular input is vital for effective reading. And since reading is an essential skill for successful function in today's society, binocular fusion at the interface between the visual system and the written language comprehension system needs specific attention and research. Jainta's research profile therefore combines interdisciplinary aspects – from physiology and optometry to psychology.
Link: http://www.fhnw.ch/technik/io

Saturday, Keynote lecture: *Binocular coordination and binocular advantages in reading.*

ABSTRACT: Reading is an essential skill for successful function in today's society; it is a sophisticated, uniquely human skill which requires the simultaneous operation of visual, oculomotor, attentional and linguistic processes. During normal reading, in most humans vergence eye movements establish a reliable and stable vertical alignment as a pre-requisite for efficient horizontal motor fusional responses (i.e. vergence movements), which in turn serve to maximise correspondence in retinal activation between the two eyes. This facilitates the sensory fusion of the two inputs (one from each eye) and ultimately provides a stable and single percept of the text during reading. Sensory fusion can take place over a small range of fixation disparities (i.e. slight alignment errors of the eyes), which are (as other vergence adjustments during reading) sensitive to quality aspects of the text. The present talk will characterize typical binocular coordination during reading and show that binocular fusion is a valuable prerequisite over which further visual and lexical processes can work most efficiently. Critically, binocular fusion processes typically lead to superior performance in reading, the so-called binocular advantage: reading speed is high and word frequency effects emerge during fixations (i.e., faster lexical processing of words that are more often encountered in a language), which is not the case for monocular reading. In other words, there is evidence that binocular vision provides clear advantages for reading which are not simply due to an improvement of the visual quality of the text (when both eyes are presented with input) but extent to lexical processing of the just read text. Thus, the complex interplay between the human visual system and the language processing system seams crucial for effective reading and the impacts of such evidence will be discussed.

ABSTRACTS

Friday, 7 October, 2016

Session 1 (9:00-11:00): Illusions and environment

The aftereffects of Müller-Lyer and Ponzo illusions in sensorimotor domain

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Following Uznadze, there have been many studies investigating the aftereffect but few of them have used visual illusions. Moreover, those that have done so have only used the Müller-Lyer illusion (Pollack, 1964; Valerjev, Gulan, 2013). As part of our continuous research (Karpinskaia, Lyakhovetskii, 2013; Karpinskaia, Lyakhovetskii, 2014), we investigated the aftereffect of different illusions in sensorimotor domain. The different illusions were used for four experimental groups: Müller-Lyer illusion, upper/bottom shaft appears longer, classical Ponzo illusion and inverted Ponzo illusion, in which bottom shaft appears longer. The neutral stimulus consisting of two shafts without any flanks were used for control group. Five groups of ten right-handed participants participated in experiment. At first, one of the above mentioned stimuli was presented ten times. Then, for testing the aftereffect, the neutral stimuli were presented thirty times. After the disappearance of each stimulus, the participant moved his/her right hand across the touch screen monitor, first along the upper shaft and then along the lower shaft from left to right. The coordinates of the start and the end points of the participant's hand movements were used to calculate the strength of the illusion and the aftereffect: this was the difference between the reproduced lengths of the shafts. Analysis of the results showed that the participants of control group neither see the difference between the lengths of the shafts of the neutral stimulus nor have any aftereffect. The participants of all experimental groups expected significant illusions, but only the classical Ponzo illusion caused significant long-time assimilative aftereffect – the participants overestimated the upper shaft of neutral stimulus. These results reveal the existence of an illusory aftereffect in the sensorimotor domain. Moreover, it depends on the type of visual illusion that allows us to suggest that the different visual illusions originated at different levels of visual system.

Acknowledgements: Russian Humanitarian Scientific Fund 16-36-01008, Saint-Petersburg State University 8.38.287.2014

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Modelling foveated vision in Matlab image processing

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The vision system uses spatially and temporally discrete data to support a view of the environment which is faithful enough to enable physical interaction. Thus, for most situations, correct metric information about the physical world is necessary. The resolution of the eye is spatially highly inhomogeneous, as the maximum resolution is achieved only in a small part of the retina called fovea. Outside of the fovea, the resolution decays almost logarithmically. A sophisticated system to change the gaze quickly between the points of interest is needed consisting of precise saccades to new targets and the ability to combine information gathered from several saccade targets in some form. In the visual cortex, the data provided from the retina are synthesized again for further processing but also in a manner where most of the area is allocated for the part of the virtual image plane near the fovea; moreover, the image is split between the brain halves. Very likely, faithful modelling of the essential inhomogeneities is the key to understanding of some optical illusions which look like aliasing artefacts caused by bad matching of sampling density and spatial frequency content of the processed signal. The main example of this type of illusion is variations of the Hermann grid, and specifically, the scintillating grid. After construction of nets of usable sampling points for the retina and the visual cortex, it is seen that even simple concepts such as a "straight line" have no priori meaning on such data. Some active work is needed to calibrate data on an inhomogeneous sampling regime to be mapped to the Euclidean geometry we are used to. From a mathematical viewpoint, this is best done by transforming the data to frequency domain, doing the shifts needed to combine data over saccades by the usual phase multiplication there, and back again to the space representation. In Matlab language, the necessary data structures and operators are constructed to resample and combine data from several fixations with intervening saccades. The only reliable source for the metrics of these operators is the sample changes induced by eye movements. It is concluded that the calibration task may be a possible cause for the abundance of otherwise useless microsaccades.

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Motion induced blindness using increments and decrements

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Motion induced blindness (MIB) describes the disappearance of stationary elements of a scene when other, perhaps non-overlapping, elements of the scene are in motion (Bonney, Cooperman, & Sagi, 2001; Wells, Leber, & Sparrow, 2011). We measured the effects of increment (200.0 cd/m^2) and decrement targets (15.0 cd/m^2) and masks presented on a gray background (108.0 cd/m^2), tapping into putative ON- and OFF-channels (Demarco, Hughes, & Purkiss, 2000; Xing, Yeh, & Shapley, 2010), on the rate of target disappearance psychophysically. We presented two-frame motion, dynamic Glass pattern, and dynamic anti-Glass pattern masks (Burr & Ross, 2002). Using the method of constant stimuli, participants viewed stimuli of varying durations (3.1 s, 4.6 s, 7.0 s, 11 s, or 16 s) in a given trial and then indicated whether or not the targets vanished during that trial. Psychometric function midpoints were used to define absolute threshold mask duration for the disappearance of the target. 95% confidence intervals for threshold disappearance times were estimated using a bootstrap technique for each of the participants across two experiments. Decrement masks were more effective than increment masks. Neither mask type nor whether the target was an increment or decrement influenced threshold consistently across all participants. These results are consisting with the notion that motion induced blindness involves brain regions distal to the mixing of ON- and OFF-channels, and that OFF-channels seem more prominent. Further, no evidence supported the statement that coherent motion energy is required in the mask to induce MIB.

Acknowledgements: The generous support of UNH's Hamel Center for Undergraduate Research is gratefully acknowledged.

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Range of comfortable brightness for self-luminous surfaces in architectural applications

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Large buildings generally require a system that guides users in and through the spaces. Self-luminous surfaces are increasingly often used for guidance and information purposes. A major advantage of display type surfaces is that many of them provide opportunities to broadcast on time information about routes to take or other relevant information. The size of such screens can vary from small rectangles up to huge LED walls of many square meter size. For optimal performance the luminance levels of such screens should be within the range of visual comfortable viewing conditions. This range is dependent on the application type and the luminous surroundings. For applications in architecture, there are no formal recommendations available. If screens or self-luminous surfaces are used for decorative purposes, requirements about comfortable brightness perception are less severe than in conditions when information is presented. To assist designer about photometric specifications for self-luminous surfaces in architectural applications, a literature study was conducted. Recommendations from several application fields have been analyzed to define brightness values for comfortable viewing conditions. Together with the results of a recent empirical study concerned with internally illuminated signs, brightness recommendations were defined for low light photopic conditions and conditions up to light levels of 200 lux on the human eye. Formal recommendations on brightness limits are only found where motorized traffic is involved. In low light conditions, rules can be adapted from screen work conditions (Fletcher, Sutherland, & Nugent, 2009). From insights about optimal luminance for legibility, upper limits for comfort conditions can be defined (Lasauskaite & Reisinger, 2015). All together the result is a set of luminance values that are given to provide designer, architects, and lighting professional's guidance on brightness for self-illuminous surfaces in architectural non traffic situations.

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Study of volumetric image depth perception for observing generic volumetric scenes

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We describe the depth perception of the true volumetric images created by a multi-planar volumetric 3D display (such as the one being developed by Lightspace

Technologies). X1405A display is used to carry out the experiments. The image produced by the display appears in a physical volume (with a physical depth). Motivation for the research is the need to tailor the multi-planar 3D volumetric display for the end user, thus it is important to understand how the user or observer perceives the produced image. So far several experimental volumetric display devices have been produced but it is yet not clear what volumetric multi-planar optical element construction should be used or what pre-processing methods can be used to enhance the perception of the volumetric image quality for the observer. The study attempts to evaluate the depth perception for expert and normal observers of such volumetric images based on how the images are (1) prepared and (2) displayed. Effects such as inter-layer aliasing, distance among the discrete planes, and aspect ratio are analyzed. Experiments are carried out using pairwise comparison method (according to ITU-R BT.1082-1 report) and analyzed using Bradley-Terry score. Results show that user perception of the volumetric image is directly dependent on how the images are prepared and displayed.

Poster session 1 (13:30-15:30)

Influence of filling discontinuity on the strength of illusion of perceived length

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In the present communication, the spatial characteristics of the filled/unfilled illusion are under consideration. An influence of the stimulus structure on the judgement of length was tested in the psychophysical experiments with monocular view through artificial pupil of 3 mm in diameter and the 300 cm distance from the monitor screen causing a screen pixel to subtend 0.4×0.4 arc min. The stimulus consisted of three white spots lined horizontally and presented against a dark background to form two spatial intervals for the length matching procedures. The testing interval was empty, and the referential interval carried a filling formed as a line segment identical with the terminal spots in width and luminance. The length of the line segment was constant, 45 min arc, whereas the extension of the referential interval varied from 45 min arc to 90 min arc, i.e., the positions of the terminal spots of the referential interval moved aside from the line segment ends symmetrically, thus, forming the empty gaps and producing discontinuities of the referential interval filling. Subjects adjusted the length of the test interval to that of the reference, and the matching errors were considered as the illusion magnitude. The data obtained from twenty-nine subjects showed a regular overestimation of the referential interval length and continues decreasing of the illusion strength with the growing discontinuity of the filling. The findings renew our previous observations (Bertulis, Surkys, Bulatov, & Bielevicius, 2014) which offer an explanation of the filled/unfilled illusion in terms of the spatial and temporal integration along a continuous excitation path elicited by the spatial filling.

References:

Bertulis, A., Surkys, T., Bulatov, A., & Bielevicius, A. (2014). Temporal dynamics of the Oppel-Kundt Illusion compared to the Müller-Lyer Illusion. *Acta Neurobiologiae Experimentalis, 74*(4), 443-455.

Dependence of filled/unfilled illusion magnitude on the completeness of filling

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In a filled/unfilled illusory pattern or the Oppel-Kundt type figure, the empty part of the stimulus appears shorter than the filled one of the same length. The physiological mechanism of the phenomenon is still unknown but deserves a wide interest for many reasons. Recently in a series of our yet unpublished studies, we have established certain regularities in the illusion strength variations in dependence on the changing the spatial parameters of the figure. We have applied a mathematical model to describe experimental results. In the present psychophysical approach, we examine the illusory effect as a function of the length of the horizontal line segment centred in the referential interval of the three-dot stimulus. The segment's length varied from zero to the complete filling of the reference, and the subjects were asked to adjust the length of the test interval to make both stimulus parts perceptually equal in size. The data gathered in experiments with twenty subjects showed a non-linear functional dependence of the illusion magnitude on the completeness of filling. The dependencies established were used to develop a new semi-empirical mathematical model whose functions were successfully applied to fit the experimental curves obtained earlier for conventional Oppel-Kundt stimuli with regularly distributed subdividing elements in the filled part.

Oppel-Kundt illusion magnitude changes evoked by the tilting of the filling element

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Investigation of geometrical illusions can substantially narrow the range of theoretical suggestions regarding the principles underlying the visual perception of spatial relationships (Westheimer, 2008). Previous examination (Surkys, et al., 2015) of the Oppel-Kundt illusion (overestimation of length of the filled part of the stimulus) with misalignment of the filling elements had yielded Gaussian-like profile of the illusion magnitude changes. In the present study, a modified version of the Oppel-Kundt figure was tested in order to assess the properties of spatial distribution of contextual interactions within the relevant visual area. We examined the illusory effect as a function of the tilt angle of the contextual line segment (length 100 arcmin) filling the referential spatial interval of the horizontal three-dot stimulus. White stimuli (luminance 75 cd/m^2) were presented in the center of a Sony SDM-HS95P monitor screen against a dark round-shaped background (5º in diameter and 0.4 cd/m^2 in luminance); the distance between the subject's eye and the screen was 300 cm. The tilt angle of the contextual segment was varied in a range from -90° to 90° around the central dot of the stimulus, and the subjects had to adjust the position of the lateral dot of the test interval to make both stimulus parts of equal length. The data collected in experiments with three subjects showed the curves similar to Difference-of-Gaussians function with zero-crossing points near ±50°. The dependencies established were used to verify the predictions of our semi-empirical computational model, and it was demonstrated that the model calculations adequately account for the illusion magnitude variations shown by all subjects. The results obtained are consistent with our previous findings in experiments with the three-part Oppel-Kundt figure (Surkys, et al., 2015) and support the suggestion on the presence of some narrow area of spatial information integration in a close vicinity of the horizontal stimulus axis.

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Surkys, T., Bulatov, A., Bertulis, A., Bielevičius, A., & Loginovič, J. (2015). Misalignment of the filling elements in the three-part Oppel-Kundt figure. *Biomedical Engineering - 2015: Proceedings of 19th International conference,* Kaunas University of Technology, 74-77.

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Superposition of differing structures in the Oppel-Kundt stimuli

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The Oppel-Kundt illusion is rather well studied experimentally at present, though there are no generally accepted theoretical explanations for its origin. For further studies, different illusory structures were tested at separate and superposed presentations in psychophysical experiments. A possible effect of summation of the perceived distortions was under consideration. There were three basic filling patterns in the referential intervals of the Oppel-Kundt stimuli: (1) a regular sequence of seven vertical stripes, (2) contour rectangle, and (3) uniformly filled rectangle forming a solid block. At stimuli superposition, two combined filling structures were raised: (4) stripes within the outlined rectangle, and (5) stripes within the filled one. The empty test interval was terminated by a stripe identical with the filling stripes and vertical edges of rectangles in height and luminance. Subjects adjusted the length of the test interval to that of the referential one, and the matching errors if occurring were considered as the illusion magnitude. The three separate versions of the filling pattern (1, 2, and 3) produced illusory distortions of about equal magnitude. The combined stimuli (4 and 5) showed readily the same values neither increasing nor decreasing the perceived distortions. Presumably, the superposed stimuli are processed as an indivisible entity, regardless of subjects' ability to recognize the components if necessary. The experimental results do not contradict the idea that the perception of continuity plays an essential role in the Oppel-Kundt illusion's manifestation (Bertulis, Surkys, Bulatov, & Bielevicius, 2014). One common structural feature inherent to all five stimuli modifications, the horizontal contour component, either real or interpolated, produces excitation continuities. The spatiotemporal integration of excitations along the true horizontal borders of the filled and outlined rectangles and the illusory contours of the stripes sequences cause quantitatively similar length misjudgements, and no summation effect can be present at contour superposition.

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Bertulis, A., Surkys, T., Bulatov, A., & Bielevicius, A. (2014). Temporal dynamics of the Oppel-Kundt Illusion compared to the Müller-Lyer Illusion. *Acta Neurobiologiae Experimentalis*, 74(4), 443–455.

Illusory depth sense of colour images in "Virtual Reality" adapters using mobile phone

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Chromostereopsis is a visual illusion whereby an impression of depth is conveyed in two-dimensional colour images. Chromostereopsis can be seen and felt also in "Virtual Reality" adapters, that induces the appearance of colour dependant depth sense and, finally, combines this sense with the source conceived depth scenario. Previously we have investigated human tolerance to the induced chromostereopsis that depends on observer's interpupillary distance, age, near heterophoria, and used correction type – typical binocular vision parameters (Ozolinsh, & Muizniece, 2015, Рожкова, & Грачева, 2014). Our present studies are devoted to investigate the induced chromostereopsis using "Virtual Reality" adapters together with mobile devices as smartphones. We did observation of composite visual stimuli presented on the high spatial resolution screen of the mobile phone placed inside a portable "Virtual Reality" adapter. Separated for the left and right eyes stimuli consisted of two areas: a) colour chromostereopsis part identical for both eyes, and b) additional conventional colour neutral random-dot stereopsis part with a stereodisparity based on the horizontal shift of a random-dot segment in images for the left and right eyes, correspondingly. The observer task was to equalize the depth sense for neutral and colored (blue-red, red-green, yellow-blue) stimuli areas. Such scheme allows to determine actual observed stereopsis disparity value versus eye stimuli colour difference $\Delta E = \sqrt{(\Delta L)^2 + (\Delta a)^2 + (\Delta b)^2}$, where L, a, and b are parameters in L*a*b colour space. The chromostereopsis sensitivity threshold for mobile blue-red stimuli, where chromostereopsis is most remarkable, was detected at $S_{ChS} \approx 2.1$[arcmin/(units of Lab-colour difference)] at our standard observation conditions. These are at the observation distance between eye pupils and phone screen of 100 mm and for adapter with +12 D ocular lenses.

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Chromatic sensitivity evaluation with static and dynamic color vision stimuli

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The ability to discriminate colors varies within the life cycle. Previous research (Paramei & Oakley, 2014) showed that the chromatic sensitivity peaks at 21-26 years of age and gradually impairs in the following decades. Wholesome evaluation of color vision requires normal chromatic sensitivity range establishment in each age group. Several studies (Barbur & Konstantakopoulou, 2012; Paramei, 2012) had shown connection between age and chromatic sensitivity; however, the results are difficult to clearly compare because of use of fundamentally diverse test stimuli and test subject groups. The computerized chromatic stimuli, created for the current study, had dynamic or static modes providing an opportunity to assess the individual chromatic sensitivity along protan, deutan, and tritan confusion axis. The achromatic circular test field (9.1 x 8.9˚ visual angle) held a circular chromatic stimulus (2˚ visual angle) for test distance of 1 meter (both test field and stimulus were composed of isolated equilateral triangles in five brightness levels (16 cd/m^2 in average)). 20 subjects (21-77 y.o.) participated in the study. The correlation between the chromatic sensitivity thresholds and age measured using static stimuli is fair to good (except for protan "green" direction, where the agreement is weak). With a probability ($p < 0.05$), we state (except for protan "green" direction, where $p = 0.06 > 0.05$) that the resulting correlation coefficients are higher than zero confirming the relationship between age and changes in chromatic sensitivity. In repeated measurements with dynamic test stimuli, a more rapid decrement of corresponding chromatic sensitivity was observed along tritan confusion axis with age. A closer agreement between chromatic sensitivity thresholds and age was obtained using dynamic test stimuli. Chromatic sensitivity threshold values increased with age using both – static and dynamic test versions ($p < 0.05$). Dynamic test procedure produced higher chromatic sensitivity thresholds than static test version ($p < 0.05$).

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Metameric light sources: a recent paradigm for functional lighting

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Recently solid-state light sources proved a great potential in energy saving, functionality, and application versatility not available before. Digital control of light spectrum opens new opportunities in human centric effects, lighting (colour) quality, and functional efficacy. Solid-state light sources were shown to be optimizable for photochemical damage control of artworks (Tuzikas, et al., 2014), circadian effect (Gall, 2002), tuneable colour quality (Žukauskas, et al., 2012), and other niche lighting requirements. On the other hand, recent studies (Royer & Houser, 2012; Vidovszky-Németh & Schanda, 2012) revealed that metameric light sources usually are perceived as different hues to the observer. Furthermore 2-degree or 10-degree photometry employed, subject age, gender, fatigue, chromatic adaptation, environment temperature, surface luminance, colour quality, and other factors must be taken into account if reliable psychophysical experiment results are expected. Here we report on the investigation of the colour matching experiment of two metameric solid-state light sources: RGB (638 nm red, 518 nm green, 451 nm blue) and AGB (598 nm pc amber, 518 nm green, 451 nm blue), using the 10-degree and 2-degree photometry at close observed viewing distance (wide viewing angle). Two side-by-side white reflectance samples were used to match perceived colour hue by controlling one of the luminaire correlated colour temperature and Duv shift from Planckian locus while another luminaire spectral power distribution was fixed. Test results showed 10-degree photometry to be more precise than 2-degree for the close-field experiments but still not exact enough to match the metameric sources within one or three McAdam ellipse deviation. Such uncertainties reveal that humans employ hybrid 2-10-degree vision on close and wide scenes by scanning the view-field. We conclude that ideal metameric light sources cannot be developed since observers will notice the colour hue difference in narrow (2 degree) or wide viewing angle (>10 degree).

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Colorimetric and circadian light characteristics of Latvian sky

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The light impacts the physiological function of organisms, particularly humans, through the blue light sensitive receptors in human retina. Melanopsin acting as a non-object vision pigment promotes day-night cycle regulation and related body functions as vigilance, body temperature, and also mood. At the moment, there is no research about circadian light properties in Latvian latitudes. However, the seasonal changes in day light properties, including physiologically relevant light, and vegetation are sufficient in northern latitudes. To identify the proportion and dynamics of circadian component in seasonal variations of light, we started continuous monitoring of radiometric data. Since 2012, total amount of radiation is available from the Solar cells plantation of Institute of Solid State Physics, University of Latvia (UL ISSP). To obtain spectral information, our team has developed the spectral radiometric system for continuous monitoring of the day light radiance information starting from April 2016. It consists of the calibrated visible range spectrometer equipped with optics for radiometric measurements. The averaged data are acquired in five minutes for full day night cycle. We provide measurements at 45 degrees' altitude in the northern part of the sky`s hemisphere. Acquired data show that clear skylight colorimetry is comparable to that of the Granada daylight database. Analysis of Granada spectral database (Hernández-Andrés, et al., 2001) showed linear behaviour for circadian light in proportion to luminance. Data acquired at UL ISSP in late spring period clearly indicated the non-linear ratios of circadian light to luminance. This result indicates the higher amounts of melanopsin regulating light at lower luminance in northern latitude compared to results calculated on the data of Hernández-Andrés et al. (2001).

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Optical system with dynamic magnification

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Optical systems with magnification are used as a low vision aids and also by the medical personal and technician. Most of those systems have fixed magnification or the magnification is changing gradually (e.g. step 0.5x). On the optical market, there are few optical systems with dynamic magnification (the magnification is changing continuously), but they are expensive. The main goal of the project was to design a more available (cheaper) solution for optical system with dynamic magnification (in a range from 2x – 5x) that will work at a specified working distance. Such systems include two aspects: mechanical and optical. We focused on results of optical system design. The technical parameters of this optical system were based on the principles of

Galileo telescope. To achieve this kind of a setup, the object rays needed to be focused on infinity to observe the object without accommodation of the eye. The designed optical system had fixed working distance but gradually changing magnification. We designed the optical system based on thin lenses later changed to achromatic doublets which strongly reduced aberrations, especially chromatic aberrations. As a final step, two zoom systems were designed. In the first one, we used optical compensation, whilst the second one was based on mechanical compensation that allowed the magnification to be changed smoothly instead of most commonly designed systems with gradually changing magnification. The size of the system can be varied to create small and portable one that can be mounted on the spectacles. Such solution can be used by e.g. surgeons or watchmakers where it is necessary to have their hands free.

Influence of object size on recognition time in mental rotation test

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The object size is one of the factors not explored in details before in many previous mental rotation studies. The aim of this study was to determine whether there is a significant impact of object size on the recognition time and precision in mental rotation task. A computerized mental rotation test was used. The task contained a pair of 2D or 3D objects – figures; a subject had to judge whether both figures were the same (but rotated) or the second figure was a mirror image of the same figure. Reaction times were measured in all variations. Experimental pairs varied in angular size – 8, 4, 2, and 1 degree; in total 480 pairs of figures were demonstrated to each subject. 61 subjects participated in our study. The results show that reaction time increased with the increase of rotation angle – this is the main result that has been confirmed since the first studies about mental rotation (Shepard & Metzler, 1971; Cooper, 1975). For 3D figures, reaction time was faster for bigger figures (8 degrees) if the rotation angle was up to 120 degrees. And conversely – when rotation angle was getting larger, smaller figures (1, 2 degrees) were recognized faster. In 2D figure, no such tendency appeared. In both 2D and 3D figures, accuracy was not affected by the figure size. Katzir, Hershko, and Halamish (2013) observed larger programmed saccade amplitudes and more saccades in larger objects. In addition, Larsen (2014) observed more saccades if the rotation angle was larger. Thus, it coincides with our results and suggests that our results most likely are related to eye movements. But this connection must be influenced by the level of the task difficulty considering different tendencies for 2D and 3D figures.

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Visual search depending on the set size and number of targets

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Many different symbols have been used in visual search tasks (Wolfe, 2001) with only one target. When we want to hold participant's attention for a longer period of time, we might use several targets. To exclude that letters are found with different speed, Landolt squares can be used. They differ from each other with one feature – the direction of a gap. However, the mechanism of processing for Landolt squares is still not yet known. In this study, Landolt squares were demonstrated on a computer screen where they were arranged in a matrix consisting of 25, 49, or 100 symbols. In each of these sets there were 0, 1, 5, or 10 targets. Overall, fifteen participants (19-25 years of age) performed 36 visual search tasks. From the results, visual search is longer as the number of targets and set size increase ($p < 0.01$). The set size is a significant factor when participant is required to find 0 or 1, and 5 or 10 targets ($p < 0.01$). Corrected time (time allowing errors) increases with increasing set size indicating that serial processing is used in this kind of tasks.

Acknowledgements: This work has been supported by University of Latvia.

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Perceptual grouping in central and peripheral visual field

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It is not entirely clear whether biological motion processing in central and peripheral visual field is equally effective. Similarly, to studying other perceptual processes (e.g. visual acuity and contrast sensitivity), the analysis of biological motion involves stimulus magnification in order to determine whether it is possible to compensate for the reduced task performance in peripheral visual field. Ikeda et al. (2005) showed that the discrimination of a point-light walker from motion noise is more effective in central visual field than in near periphery and that stimulus magnification cannot compensate

for the reduced performance in visual field periphery. Biological motion perception in visual noise involves motion perception and perceptual grouping by proximity and similarity, as well as figure-ground discrimination. Here we raise the question whether the reduced performance in peripheral visual field is affected by different perceptual mechanisms of biological motion, simple motion, or perceptual grouping. By using adaptive staircase method BUDTIF (Campbell et al., 1968) we analyzed the threshold for number of noise points sufficient for object recognition, when the object is formed by 12-13 points representing biological motion, simple motion, or static grouping task. The results demonstrate that biological motion recognition is possible in a higher number of noise dots than simple motion and static grouping task, one more time emphasizing the significance of social information in our visual system. Stimulus magnification cannot compensate for reduced performance in either of the demonstrated tasks, indicating that the reduced performance of biological motion perception demonstrated by Ikeda et al. (2005) might be associated with different perceptual processes of figure ground discrimination in central and peripheral visual field. Similar results are demonstrated by Tran et al. (2011), indicating a reduced performance of figure ground discrimination for patients with age-related macular degeneration (ARMD).

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The effect of emotional arousal environment on first graders reading

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The development of semantic reading in the first grader is the indicator of his ability for the future learning at school. At the same time, it is necessary to point out the complex nature of reading and its relation to the personal experience. This research is devoted to the psycholinguistic study of semantic reading’s formation and its interrelations with emotional arousal environment. 23 first graders (age 7.5 – 8.5 years; 13 boys and 10 girls) participated in the study. We used Granovskaya’ projective method of psychological testing "I am happy" (Nikol'skaya, & Granovskaya, 2000) to find the basic characteristics of emotional arousal environment, standard diagnostic text for the first grade to determine the reading time and the completeness of the text’s reproduction and Thorndyke’s propositional analysis of the text and its reproduction (Thorndyke,1977). The interrelation between all basic characteristics of semantic reading such as quantity of mistakes, time of reading, and completeness of retelling are at the center of the complex scheme. There is a direct interrelation between quantity of mistakes and time of reading, and a reverse interrelation between completeness of retelling and other characteristics of reading. Personal experience of the first grader also plays an important role in reading formation as complex structure. Family and the problems of subject's environment are positively interconnected with quantity of mistakes. The communication is directly connected with time of reading. Integrative propositional analysis of the text's reproduction shows that level and type of correlation depends on the level of proposition. Proposition of the first and second level is connected with a family's factor, and proposition of the third level – with factor of activity, differed from an educational or game activity. Thus, the structure of the main interrelations between propositional structure of the text, the characteristics of semantic reading, and components of emotional arousal environment of first grader are revealed.

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Session 2 (15:30-17:30): Learning and visual perception

Accommodation amplitude in school-age children

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In children, intensive near work affects accommodation system of the eye. Therefore, it is especially important to evaluate accommodation functions in children because problems with accommodation system can affect their learning capability and could be related to development of myopia. Due to anatomical parameters, younger children use to read in smaller distances then older children (Wang et al, 2013); and we could expect that accommodation system in younger children could be affected more than in older children. We wanted to test this hypothesis. Some authors (Sterner, Gellerstedt & Sjöström, 2004) showed that norms of accommodation amplitude developed by Hofstetter (1950) not always could be applied in children. We also wanted to verify these results. In 106 children (age 7-15 years), accommodation amplitude was measured before and after lessons using subjective push-up technique (with RAF Near Point Ruler). In addition, we measured distance visual acuity in both sessions. The results showed that visual acuity does not change significantly during the day. However, accommodation amplitude reduced significantly ($p < 0.05$) during the day and decrease of accommodation amplitude was similar ($p > 0.05$) in different age groups (about ~0.70 D). Results showed lower accommodation values compared to average values calculated according to the Hofstetter equation ($p < 0.05$). We can conclude that most of the children have significant visual fatigue during the day and it is important to control that they make regular visual breaks to rest their eyes.

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Does binocular instability affect reaction times and procedural motor learning in developmental dyslexia?

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Developmental dyslexia is considered a long-life disorder. Subjects with dyslexia suffer not only from reading problems but more general motor deficits can be found as well, i.e. impaired saccades, slower reaction times in eye-hand tasks, impaired body balance, and/or deficits in motor learning. Motor deficits in dyslexia are often interpreted as dysfunction in the area of cerebellum, which is involved in controlling muscle coordination and motor learning. As studies show, some visual factors may be correlated with dyslexia. Since binocular instability may cause poor eye-hand coordination, we were interested in the influence of unstable binocular fixation in dyslexia on visual-motor responses and procedural motor learning (PML). In the first part of experiment, fixation disparity (FD) and stability of FD was investigated subjectively by Wesson/Mallett tests. In the second experimental part, modified versions of a simple sequential reaction time task was used to measure reaction times (RT) and ability to PML. Stimuli were presented in 12-item sequences on the monitor and controlled by PC. Subjects had to indicate position of the stimulus by pressing the buttons on the keyboard. RT and Error were compared between Old and New sequences. Results of 29 subjects with dyslexia (DG) and 30 controls (CG) were analyzed in the study. 14 subjects of DG and 15 of CG performed the PML experiment monocularly and the second half of DG and CG group – binocularly. DG experienced more instability of FD compared to the CG. Both dyslexic groups exhibited impaired PML. However, in binocular viewing conditions DG reacted much slower than the CG. Unstable binocularity in dyslexia affects RT but cannot be responsible for weak ability to PML. Both impaired PML and instability of FD in dyslexia may reflect deficits in the area of cerebellum, which seems responsible for poor visual-motor coordination and weak body balance in this group of individuals.

Acknowledgements: We would like to thank Milena Szady, Zofia Szymankiewicz and Natalia Waligórska for technical support during data aquisition.

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Interviewing children with reading difficulties about environmental factors influencing their reading performance

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Learning to read is a milestone during primary school and the foundation for lifelong learning as well as participation in society (OECD, 2014). From a visual perspective, reading is a complex task and it requires the effortless and rapid processing of fine visual details (Hyvärinen & Jacobs, 2013). The efficiency of visual processing is based on the child's visual physiology, but also depends on the environmental setting, which is rarely considered in assessment and intervention. The World Health Organization (WHO) includes environmental factors (physical, social, and attitudinal) as essential aspects in its International Classification of Functioning, Disability and Health (ICF) to describe and gather information about functioning and disability (WHO, 2001). It allows the detection of environmental barriers and facilitators for capacity and performance of activities such as reading. This exploratory study investigates reports of children with reading difficulties on the influence of physical environmental factors (e.g., contrast condition, font size) on their reading performance. The semi-structured interview was developed following the ICF categorization of environmental factors which were modified specifically to capture visual aspects. Thirty German children with reported reading difficulties from third to fifth grade were interviewed and the evaluation of data was employed by a qualitative content analysis (still in progress). The collected data demonstrates that the majority of the interviewed children were able to give detailed information. The analysis of interview statements shows their ability to draw very precise lines between specific environmental factors and the effect on their reading performance. Frequently indicated factors were font size (n = 24) and light condition (n = 16). These results illustrate children's experiences of environmental factors to impact reading and highlight their ability to give specific information about individual environmental barriers and facilitators. This reveals an important source to guide assessment and intervention for even young children with reading difficulties.

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Parameters affecting coherent motion perception

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Random dot stereograms are used to detect global motion perception or coherence thresholds. It shows a wide dispersion between researches: 5.6±0.4% (Ridder, Borsting, & Banton, 2001), 15.3±4.7% (Milne et al., 2002), and 25% (Slaghuis, & Ryan, 1998). The coherence thresholds varied due to different parameters of the stimulus, applied psychophysical methods, and the peculiarities of perception by integrating the information. The purpose of our study was to determine the most effective type of parameters for decreasing coherence threshold. Coherence thresholds were measured by changing the parameters: dot speed, frame rate, eccentricity, and trajectory of noise dots. We created a stimuli and algorithm of the modified staircase procedure using 4AFC psychophysical adaptive method. Stimulus speed (2 deg/s and 5 deg/s) for the coherent and noise dots was the same. Stimulus was a circle with a radius of 6.2 deg at 50 cm viewing distance. We used 160 noise dots that moved in eight directions. Coherence was increased in one of the four directions. We determined the prevalence of dots in percentage. Motion perception threshold decreased with increasing the speed of stimulus dots. Motion perception threshold increased with changing frame rate and show the minimum at 20-25 frames per seconds. Shortening the trajectory of noise stimulus, coherence can be distinguished faster. At 12 degree retinal eccentricity, the coherence thresholds increased compared with central fixation and showed the biggest difference in thresholds. When using similar parameters for stimulus, global motion perception is worse, because the integration of information about coherence takes place on the only common property (percentage of signal dots leads to one of the eight directions). Information processing of global motion is based, primarily, on the integration of the different trajectories and, secondarily, on coherence. The quality of perception depends on the amount of information or the number of frames/s.

Acknowledgements: The study was supported by ESF project No Nr.2013/0021/1DP/1.1.1.2.0/13/APIA/VIAA/001

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Effects of mental fatigue on visual grouping

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Instead of selecting arbitrary elements, our visual perception prefers only certain grouping of information. There is ample evidence that the visual perception is substantially impaired in the presence of mental fatigue. The question is how selective visual attention, which can be considered a top-down controlled neuronal gain mechanism, is influenced. The main purpose of our study is to determine the influence of mental fatigue on visual grouping of definite information – color and configuration of stimuli in the psychophysical experiment. Individuals provided subjective data by filling in the questionnaire about their health and general feeling. The objective evidence was obtained in the specially designed visual search task were achromatic and chromatic isoluminant stimuli were used in order to avoid so called pop-out effect due to differences in luminance. In addition, individuals were instructed to define the symbols with aperture in the same direction in four tasks. The color component differed in visual search tasks according to the goals of the study. The results reveal that visual grouping is completed faster when visual stimuli have the same color and aperture direction. On average, the shortest reaction time is in the evening. What is more, the results of reaction time suggest that analysis of two grouping processes compete for selective attention in the visual system when similarity in color conflicts with similarity in configuration of stimuli. The mentioned effect increases significantly in the presence of mental fatigue. But it does not have strong influence on the accuracy of task accomplishment.

Saturday, 8 October, 2016

Session 3 (9:00-11:00): Binocularity

Review of fixation disparity: methods, findings, concepts

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Observers with normal binocular vision may have a non-optimal fusional state of the two retinal images: a disparity may occur on an oculomotor and/or sensory level. In optometry, the „subjective fixation disparity" is indicated by a perceived horizontal offset of physically aligned monocular nonius lines which are imbedded in a stationary fusion stimulus. Conventional procedures include tests in near and far vision, and tests of „fixation disparity curves" as a function of prism load or viewing distance: relations with visual symptoms have been reported. The „aligning prism" for compensating a subjective fixation disparity may be used as prism prescription for constant wear in cases of visual symptoms. In research, eye movement recordings allow to measure the dynamics of vergence and the „objective fixation disparity", i.e. the misalignment of the visual axis relative to a monocular calibration. Measurements in real visual tasks as reading allows showing, e.g., regulatory vergence movements during fixations and advantages of binocularity in reading. Simultaneous measurements of objective and subjective fixation disparity revealed that these two measures are not equivalent, rather large discrepancies can occur. The process of fusion seems to affect the validity of nonius lines as indicators of the vergence angle. Still, objective and subjective fixation disparity tend to be correlated and share some common properties as the relation to heterophoria, which describes the vergence tonus state. Mathematical models of vergence suggest that the fixation disparity is a consequence of an imbalance between convergent and divergent dynamic mechanisms of vergence. Dynamic disparity vergence movements are suggested to reduce the objective fixation disparity during moments of fixation. To summarize, objective fixation disparity describes the oculomotor vergence misalignment; this vergence error is compensated by stages of sensory and neural fusion mechanisms; a residual subjective fixation disparity may remain.

A new approach to fixation disparity: determining aligning prisms without using trial prism lenses

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The lecture will provide the information about the measuring and correcting fixation disparity (FD) to give the delegates more understanding and boost their confidence when treating symptomatic patients with aligning prisms. Why is the use of aligning prisms still not widespread in optometry? The advantages and disadvantages are

discussed to increase comprehension, even though this discussion about prism adaption is still ongoing. Actual research using the simultaneous recording of objective and subjective FD has found significant changes in both types of FD with large effect sizes after wearing prisms for about 5 weeks. A new approach to determine the aligning prism will be introduced. Using electronic devices, an interactive measurement of fixation disparity minimizes the influence of the examiner. An innovation is the direct conversion of the fixation disparity value (min arc) into a prism amount (pd). Essential background information about the new system will be presented to explain its functioning. In summary, using aligning prisms for asthenopic patients is an important option once other reasons for asthenopia have been ruled out.

Effect of vision therapy on vergence response in accommodation and vergence problems

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Spending a lot of time working at near can cause tension in visual system and typical complains – blurred vision at near, eye tiredness, headaches that can be related to problems in accommodation and vergence system. These problems are treated using vision therapy – exercises affecting eye muscles, improving accommodation and fusional system performance. Mainly studies are analyzing the results of convergence insufficiency treatment – the changes in clinical findings such as convergence near point (Scheiman et al., 2005a; Scheiman et al., 2005b) and objective findings (Alvarez & Kim, 2013). After therapy, near point of convergence decreases, vergence peak velocity increases, eye movements become more symmetric, and no saccades appear within eye movement response (Alvarez & Kim, 2013). There are few studies analyzing other types of accommodation and vergence problems. The main goal of this study was to evaluate the effect of vision therapy on the objective parameters of vergence response. Four participants with convergence insufficiency, one with convergence excess, and one with accommodation weakness had two weeks of vision therapy. Control group (five participants with normal binocular vision) had no vision therapy. Before treatment, all participants had saccades within vergence response; if saccades were during acceleration of vergence response, they increased the peak velocity of vergence both for convergence and divergence. After vision therapy, changes in subjective and objective parameters were observed: all participants with convergence insufficiency had normalized convergence near point, reduced subjective complains, number of responses with saccades decreased only in convergence response, vergence peak velocity (in responses without saccades) reduced in convergence insufficiency group and increased in participants with convergence excess and accommodation weakness. Asymmetry of eye response did not change in most of the participants (except one with convergence insufficiency). Vision therapy is effective in accommodation and vergence problems and affects both subjective and objective vergence response parameters.

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Examining crowding using a real three-dimensional experimental setup

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The phenomenon of impaired recognition of peripherally presented visual targets when flanked by similar stimuli is referred to as crowding. Common studies in a two-dimensional space showed that lateral distances are critical: The extent of crowding depends on eccentricity of the target stimulus and on the spacing between target and flanking stimuli (Bouma, 1970). The question of whether also distances in depth affect crowding was until now usually investigated using virtual depth (e.g. Astle, McGovern, & McGraw, 2014). However, virtual and real depths differ, for example with respect to the accommodation-vergence mismatch and to effects of blur. Thus, we made an attempt to study crowding in real depth. In our experimental setup real depth is implemented by two screens observed via a semi-transparent mirror. Thus, moving the two screens along the line of sight allows simultaneous stimulus presentation with real depth differences. In a first validation study with 18 participants, a fixation cross was fixed in a depth of 190 cm. Single and flanked Landolt rings were presented in 2° of eccentricity in the same depth as fixation, or in front of (170 cm) or behind (215 cm) the fixation depth. Preliminary results concerning recognition performance show a similar extent of crowding for flanked targets presented in front of or behind the fixation depth and flanked targets in the fixation depth. But, concerning reaction times crowding for flanked targets presented in front of or behind the fixation depth is reduced compared to flanked targets in the fixation depth. With the experimental setup, crowding successfully was induced in different depths. In further studies, the influence of target and flankers in divergent depths on crowding will be investigated.

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Poster session 2 (13:30-15:30)

Open-view system for measurements of accommodation and vergence

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With increasing near work, vision problems related to accommodation and vergence system dysfunction are becoming more frequent. Standard clinical tests allow to measure each system separately therefore understanding of near triad performance (accommodation, vergence, and pupil response) in real time with dynamic free space tasks is limited, but represents an important topic for further research. Our approach integrates eccentric photorefraction and video-oculography for simultaneous measurements of accommodation, eye movements, and changes in pupil size. We applied an electro-mechanical device for vergence stimuli presentation that uses moveable single piece targets for high speed stimuli presentation at desired distances. IViewX Hi-Speed (500 Hz, binocular) eye tracking system was used to register vergence eye movements and pupil changes. For accommodation measurements, we used a self developed device based on an eccentric photorefractive principle. The main challenge lies in combination of two measurement techniques that both use near infrared light. Overlapping of both near infrared illumination systems create light pollution that we minimized by using strong intensity light for eye tracking and much weaker intensity for the photorefractive system. Even though the various illumination paths are implemented, the lights of the eye tracking system are off the visual axes while the accommodation system illumination is only slightly of the axis to provide necessary light for photorefraction measurements. We tested the changes in pupil size and pupil centre detected by the eye tracker if additional infrared lightning from the photorefractor was applied. If photorefractor was switched on, the data demonstrated statistically significant increase in pupil size (in horizontal direction) and pupil centre shifted to the nasal part in most of the measurements. Thus, simultaneous work of the eye tracker and photorefractor will affect the evaluation of eye gaze position. Other ideas for simultaneous measurements of accommodation and vergences will be tested.

Acknowledgements: The study was supported by ESF project No 2013/0021/1DP/1.1.1.2.0/13/APIA/VIAA/001

Binocular coordination in reading when changing background brightness

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There are two contradicting results reported concerning binocular coordination in reading: Liversedge, White, Findlay, and Rayner (2006) reported a dominance of uncrossed fixations, whereas Nuthmann and Kliegl (2009) observed more crossed fixations in reading. Based on both and continuing studies, we conducted a reading experiment varying brightness of background and font. Calibration was performed using gratings presented on grey background, and text had to be read either on dark or on bright, or on grey background. The data replicate both former results; those showing a predominance of uncrossed fixations (Liversedge, et al., 2006) when reading on dark background, as well as those showing a predominance of crossed fixations (Nuthmann & Kliegl, 2009) when reading on bright background. The results further demonstrate that the font brightness only slightly contributes to this effect. Thus, our data clearly show that fixation disparities during reading vary with background brightness. There are various interpretations suggested according to three lines of arguments: First, these results may suggest an interpretation in terms of vergence movements that denote systematic variations of perceived distance. Second, variations in vergence might be due to adjusting the mechanisms of the near triad, which are vergence, accommodation, and pupil dilation. Third, respective results might be the result of an artefact when measuring eye movements with video-based eye trackers (e.g., Drewes, Masson, & Montagnini, 2012). The origins of the effect have to be clarified in future research.

Acknowledgements: The work reported is performed within the Transregional Collaborative Research Centre SFB/TRR 62 "Companion-Technology for Cognitive Technical Systems" funded by the German Research Foundation (DFG).

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Differences in cortical activation between pure volitional saccades and pure volitional vergences

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As it is commonly known, eye movements may be elicited reflexively by stimuli appearing in visual periphery, and voluntarily by the endogenous cognitive control processes. Although the neural circuities of saccades are well understood, it is still difficult to identify clearly the differences between reflexive and volitional vergences. The aim of this study was to increase our understanding of volitional eye movement preparation by measuring cortical activation related to different types of eye movements. Nine LEDs were located at eye level on three isovergent circles at near (20 cm), middle (35 cm), and far (1 m) distance. The eccentricity of the lateral LEDs was 10° for all distances. The subject was instructed to look at the target LED in accordance with the indication (color of the middle LED) as quickly and precisely as possible. The electroencephalogram was registered from 64 active electrodes (Brain Products). The differences between vergence and saccadic movements were observed 120 ms before the eye movement took place. Both convergence and divergence evoked significantly more positive ERP than saccade on C1/C2 channels. Moreover, in the frontal lateral areas (F7/F8), registered potential associated with convergence was more negative than for saccade. In turn, in the temporo-parietal regions (TP7/TP8), ERP was more negative for saccade than for convergence. Just before the eye movement, ERP for saccade was also more negative than for vergence movement in the temporo-parietal areas, whereas divergence was more negative than saccade in the frontal area (AF3/4, AF7/8, F1/F2, F3/F4, F7/F8). The obtained results suggest that preparation of different types of volitional eye movements is characterized by different neural circuities where vergence movements, particularly divergence, caused strong response of frontal areas, whereas saccade engaged central, temporo-parietal, and parieto-occipital areas.

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The time course of adaptation depending on subject's refraction

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Blur adaptation is a phenomenon when visual acuity improves after exposure to blur of certain time period. This improvement is due to neural compensation for the blurred image. There occur no anatomical or physiological changes (Mon-Williams, et al., 1998). It is previous mentioned that myopes have higher tolerance to blur but visual acuity improvement due to blur adaptation is equal for myopes and emmetropes (Poulere, et al., 2013). The aim of this study was to evaluate blur adaptation during 30 minutes long period for emmetropes (n = 6) and myopes (n = 6). Two different levels of optical blur were provided using +2.00 D and +3.00 D ophthalmic lenses in addition to subject's best spherocylindrical correction in the trial frame. Blur adaptation was evaluated in monocular and binocular conditions. Visual acuity was measured using Freiburg Visual Acuity Test (Bach, 2007; Bach, 2015) every three minutes during adaptation period. Results showed statistically significant improvement of visual acuity during 30 min in the group of myopic subjects in all conditions (both of optical blur levels and both of viewing conditions). But we did not find significant differences between amount and dynamics of improvement in visual acuity in different conditions. Consequently, main cause of blur adaptation is adaptation time. In the group of emmetropic subjects, statistically significant improvement of visual acuity was observed only in binocular conditions using +3.00 D lens, although, tendency of visual acuity to improve was observed in other conditions. Unlike myopic subjects, emmetropes showed significant difference in amount of improvement of visual acuity between both blur levels – improvement of visual acuity was more evident using +3.00 D lens. In one subject, repeated measurements improved stability of results; correlation coefficient between improvement of visual acuity and adaptation time doubled from first to third measurement session.

Acknowledgements: Acknowledgements to Department of Optometry and Vision Science (Univerity of Latvia) for support.

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Optimal optotype structure for monitoring visual acuity

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There are still no generally accepted optotypes for monitoring visual acuity. Such tasks as monitoring visual development, early diagnostics, treatment tracking, impose heavy demands on the test stimuli: (1) they must be suitable for all ages and repeatable examinations; (2) they must be accurate enough for providing a possibility to detect even small changes in visual acuity. On the basis of consideration, assuming that the ideal stimuli should be gratings of various spatial frequencies, we investigated certain compromise stimuli similar to gratings – modified 3-bar optotypes (M3B) that were compared with the standard 3-bar optotypes (S3B) and tumbling-E. Making M3B from S3B, we changed the initial bar lengths trying to eliminate low-frequency components in the difference Fourier-spectra of the optotypes with horizontal and vertical bars. Such modification precluded a possibility to use low-frequency components in stimulus orientation recognition. To demonstrate the benefits of the M3B, two series of visual acuity measurements were conducted aimed at the comparative analysis of psychometric function (PF) variability and test-retest reliability of measurements based on M3B and other optotypes. (1) PFs were repeatedly obtained in 5 subjects using S3B and M3B. It was revealed that PFs for the M3B were sufficiently stable while PFs for S3B could change radically with time due to learning how to use the low-frequency Fourier-components properly. (2) Test-retest reliability of visual acuity measurements in 50 subjects was compared for S3B, M3B, and also for tumbling E – the optotype very close in shape to the 3-bar stimuli. The results confirmed the expected advantage of the M3B. The results obtained support the idea that the optimal optotype structure for monitoring visual acuity should be similar to grating and should have no low-frequency cues for the stimulus recognition.

Acknowledgements: Supported by the Program III.3 of DNIT Russ Acad Sci, 2016.

Mobile devices for studies of binocular summation of colour stimuli

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Human visual ability to fuse two little different eye images as opposed to binocular rivalry and suppressing is of continual researcher interest due to eye refractive errors, presence of unilateral cataract, and various other eye pathologies. In present studies, visual stimuli were demonstrated on a 5' mobile phone screen inside a "Virtual Reality" adapter that allowed separation of the left and right eye visual fields. Contrast of the retinal image was controlled by the image on the phone screen. Such optical pathway separation allows to demonstrate spatially variant images for both eyes. We applied grey, similar to those used in papers (Kingdom, 2012; May, & Zhaoping, 2016), and different colour (two opponent colour to vision – red-green along L*a*b* colour space) spatial periodic stimuli as visual stimuli for the left and right eye. May and Zhaoping (2016) demonstrated that numerical processing of their images can result in more or less distinct clockwise or counter-clockwise slanted Gabor gratings. We performed computer modeling with numerical addition or subtraction of signals similar to processing in brain via input stimuli decomposition in luminance and colour opponency components. It revealed the dependence of the contrast value of one (e.g., left) eye stimuli, where resulted image slant orientation changes between clockwise and counter-clockwise, on the eye image contrast and colour saturation, and on the strength of the retinal aftereffects. Psychophysically, we observed that existence of subjective psychophysical equilibrium point SPE in the perception of eye inputs, when retinal image contrast of the one eye is decreased, occurred only in the presence of the prior visual adaptation to a slanted periodical grating. We analyzed also user-friendliness of experimentally used mobile device stimuli emission spectra paying attention to areas sensitive to macular pigment absorption spectral maxima (Landrum, & Bone, 2001), and blue areas where the intense irradiation could cause (West, et al., 2011) abnormalities in periodic melatonin regeneration and deviations in regular circadian rhythms.

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Interactive computer trainings for improvement of binocular functions

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Binocular vision disorders produced by heterotropia or heterophoria may block the patient’s ability to form single binocular image even when eye axes are forced to orthophoric position (by prisms, optical correction, or surgery) (Kämpf et al., 2008; Rozhkova et al., 2015a; Rozhkova et al., 2015b). The attempt was made to assess the capacity of low frequency changeover of the separated left and right visual stimuli and combined dichoptic stimuli for training the binocular image formation. Two training programs for binocular vision treatment, based on colour separation technique (anaglyph), were used. One group (15 subjects, 9 – 15 years) was trained with the program based on low frequency changeover; another group (15 subjects, 9 – 15 years) was trained with the program based on combined dichoptic stimuli. All subjects had binocular vision disorders. Each subject had undergone 10 training sessions for 10 minutes. To evaluate the effectiveness of such treatment, visual acuity, accommodation, and binocular vision quality (single binocular vision, unstable binocular vision with intermittent diplopia, diplopia, monocular vision) were assessed before and after the training course. In the first group, 10 patients demonstrated progress in the binocular functions. The microstrabismus was eliminated in one patient, and the heterophoric angle was eliminated in two patients. Far visual acuity improved in 9 patients by 0.075 LogMAR, and near visual acuity improved in 8 patients by 0.080 LogMAR. Accommodation range increased, on average, from 2.9 to 3.6 diopters. In the second group, 11 patients demonstrated progress in the binocular functions. Heterophoric angle had decreased in two patients. Far visual acuity was improved in 9 patients by 0.075 LogMAR, and near visual acuity improved in 11 patients by 0.075 logMAR. Accommodation range increased, on average, from 3.3 to 3.8 diopters. All improvements were statistically significant (t-test; $p < 0.05$). The data obtained demonstrate effectiveness of interactive dichoptic trainings with low frequency changeover and combined dichoptic stimuli for binocular function improvement.

Acknowledgements: The research was supported by the grant of the Ministry of Education and Science of Russian Federation RFMEF160414X0076.

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Computer-aided techniques in analysis and treatment of strabismic suppression: practical issues

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The existence of binocular suppression zones is an obligatory symptom of any concomitant strabismus cases. However, suppression can be manifested in varying area and degree (Black, Thomson, Maehara, & Hess, 2011; Economides, Adams, & Horton, 2012; Pratt-Johnson & Tillson, 1984). The assessment of the binocular suppression map (representing the area and the degree of the pathology) could help in optimizing the treatment procedures and to trace the progress in normalization of binocular functions. It is evident that such mapping could only be achieved by means of computerized techniques. At present, there are no commonly accepted approach for strabismic suppression analysis and treatment by means of computerized methods. In part, such situation is due to deficiency of data obtained in practical work. Therefore, more investigations should be undertaken to create a basis for developing proper methods and procedures. We had a possibility to work with 3 interactive computer programs created for investigating spatial properties of binocular suppression zone and degree of pathology and 2 programs for treatment. The programs implied either colour or shutter-glasses methods of left-right image separation. All programs appeared to be rather effective but each one had its benefits and shortages. According to our experience, it appeared to be beneficial to use prismatic correction during diagnostics/treatment procedures, to employ a triple fixation target containing the parts for left, right and both eyes, and to choose simple scenarios of procedures. These approaches provide a possibility to obtain sufficiently informative suppression maps in the central zone, and to make treatment procedures rather fast and effective in comparison to other realizations. Computer-aided methods for studying and treating binocular suppression could be significantly improved by means of using proper working conditions, adequate fixation targets, and facilitated scenarios.

Acknowledgements: Supported by the Program III.3 of DNIT Russ Acad Sci, 2016.

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Visual acuity and contrast sensitivity in different keratoconus stages

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Patients with keratoconus have changes in the optical quality of the cornea and reduced retinal image quality (Jadidi, et al., 2015; Jinabhai, et al., 2012). Prior to observing a decrease in visual acuity in patients with keratoconus, changes are observed in contrast sensitivity at medium and high spatial frequencies. Various studies have demonstrated that patients with keratoconus have significant loss of contrast sensitivity while the size of this loss varies in different studies (Marsack, et al., 2007; Jinabhai, et al., 2012; Stein, & Stein, 2011). None of these studies had analysed reduced contrast sensitivity depending on the position of apex of corneal conus which might explain the various results of the studies. The goal of our study was to evaluate the correlation between the position of the corneal apex of keratoconus and the visual acuity and contrast sensitivity. Our hypothesis was that the worse visual acuity and contrast sensitivity will be observed if apex will be closer to the central visual axis and contrast sensitivity reduction will start at lower spatial frequencies. The visual acuity and contrast sensitivity was evaluated using the FrACT test (developed by Bach). The contrast sensitivity was assessed at the following frequencies: 1, 3, 5, 7, 9, 11, 13, and 15 cpd. 24 eyes with keratoconus was analysed. A statistically significant difference was observed in eyes with the apex at the centre of the cornea compared to the eye with normal contrast sensitivity both with ($p = 0.007$) and without ($p = 0.0009$) spectacle correction. The results show statistically significant difference in contrast sensitivity for eyes with the apex at the centre and on the periphery without correction ($p = 0.01$). There is not statistically significant difference from the normal contrast sensitivity if the apex is on the periphery both with and without spectacle correction. Results do not confirm the hypothesis: if the apex is closer to visual axis, the contrast sensitivity reduction will begin at lower frequencies.

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Vertical zones of clear vision with progressive addition lenses

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Progressive addition lenses (PALs) are widely used (Sheedy, 2004) because of their advantage of a gradual increase in the near vision addition with lowered eye inclination; however, this benefit is connected to two types of limitations. The first limitation refers to the horizontal direction: clear vision for intermediate and near vision is only possible within a central vertical zone, while astigmatic distortions are present in the left and right peripheral visual fields. The second limitation refers to the vertical direction and is the topic of the present study: in order to use the required addition for a given viewing distance, the inclination of the eyes and the head must be adjusted, so that the visual line intersects the lens at the point with the required near vision addition. In optometry, PALs are described by the distribution of the near addition power within the lens dimensions. From an ergonomic point of view, it would be helpful to know the corresponding viewing distances and gaze angles, where clear vision is provided. Thus, the user should know the vertical zone of clear vision of his/her spectacles to place the computer monitor at a position with clear vision and comfortable head posture (Ankrum, & Nemeth, 2000; Masseida, Philip, Wicher, & Jaschinski, 2013; Jampel, & Shi, 1992). The vertical zones of clear vision can be measured with an elaborate instrument, i.e. the 'inclined optometer' (König, Haensel, & Jaschinski, 2015). Simple test methods are suggested that can be used by the optometrist or ergonomist. Further, calculations of the individual vertical zones of clear vision of PALs can be made based on the distribution of the addition power within the lens. In conclusion, measurements or calculations of the vertical zones of clear vision of PALs are proposed in workplace dimensions, depending on the lens characteristics and head inclination (http://ergonomic-vision.ifado.de/en).

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Assessment of iridocorneal angle

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Angle-closure glaucoma is one of the most common causes of blindness in the world (Quigley, & Broman, 2006). Diagnosis and treatment are related to the assessment of the iridocorneal angle. Patients with a narrow iridocorneal angle are at a higher risk of developing angle-closure glaucoma (Nongpiur, Ku, & Aung, 2011). Therefore, it is important to assess the iridocorneal angle in optometric practice to identify and prevent manifestations of the disease before it starts. However, in order to properly assess the iridocorneal angle, it is important to follow the proper evaluation technique (Friedman, & He, 2008). The purpose of the study was to evaluate the accuracy of the measurement of the iridocorneal angle in optometric practice and determine factors that can affect the evaluation of the angle. Assessment of the iridocorneal angle (ICA) was performed with the van Herick technique using a slit-lamp under different lighting conditions and with anterior segment optical coherence tomography (AS-OCT). In order to more accurately assess the ICA, the grading of the van Herick technique was improved for open ICA assessment, dividing the fourth grade of the technique into four subgrades. In photopic lighting, the ICA is measured 1-2 grades wider than in mesopic which is consistent with literature (Masoodi, et al., 2014). Therefore, it is important to assess the ICA in mesopic lighting in which the iris widens and the ICA is in a narrower position compared to photopic lighting. The ICA is wider in myopic people than it is in emmetropic people which is consistent with literature (Hosny, et al., 2000). Five different subjects were assessed with AS-OCT and the van Herick technique under the same lighting conditions. Results show that the van Herick technique is sufficiently precise in the assessment of the ICA in optometric practice.

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Session 4 (15:30-17:30): Clinical

Differences in the development of deprivational and disbinocular amblyopia

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Amblyopia is a neurodevelopmental disorder associated with disrupted binocular vision during early childhood, but the dynamics of changes in visual structures is not yet fully determined (Daw, 2006). We have investigated development of impairments in the dorsal lateral geniculate nucleus (LGN) – the subcortical structure through which information is supplied from the retinae to the visual cortex for each eye via separate layers. Histochemical staining for cytochrome oxidase (CO) (Wong-Riley, 1979) – a mitochondrial enzyme involved in energy production – was used to estimate functional activity in LGN of unilaterally convergent strabismic (SK) and monocularly deprived kittens (MDK). Using images of stained LGN sections, the optical density in eye-specific layers A and A1 was measured and Michelson contrast between them was calculated. Significant differences ($p<0.05$) between CO-activity in layers innervated by intact and impaired eyes were revealed in the projection of the entire visual field in MDK, but only in the projection of central 10-15 degrees of the visual field in SK. In MDK, a relative decrease in CO-activity was found in LGN layers of both hemispheres corresponding to the deprived eye; however, in hemisphere ipsilateral to deprived eye, this was observed earlier (two months old) than in the contralateral hemisphere (between three and five months). In SK, the dynamics of changes in the hemisphere ipsilateral to squinting eye was similar to monocular deprivation changes. However, in opposite hemisphere at the age of two months, the CO-activity in the layer innervated by squinting eye exceeded CO-activity in the intact eye layer. At the age of three months, this difference in activity was decreased; and at the age of five months, the CO-activity in the intact eye layer was higher than in the squinting eye layer. We suggest that during development of congenital strabismic amblyopia, alternating fixation changes into suppression of squinting eye.

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Current trends of myopia management strategies in clinical practice

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Myopia is a global public health issue; however, no information exists as to how research findings on retardation strategies are being adopted in clinical practice. A self-administrated, internet-based questionnaire (SurveyMonkey, USA) was distributed, through professional bodies to eye care practitioners globally. The questionnaire included questions on the awareness of the increasing prevalence of myopia; the perception of the relative efficacy and employment of the available myopia management strategies; the annual progression rate of myopia they believe requires management; preferred management strategies dependence on patient's age and refractive error; and the rationale for prescribing single vision spectacles as primary method of management. Nine hundred and seventy-one responses were received from Africa (n = 6), Asia (n = 291), Australasia (n = 119), Europe (n = 339), North America (n = 133), and South America (n = 82), respectively. Concern was higher (median 9/10, 'not at all' to 'extremely' on a 10 point scale) in Asia than any other continent (7/10, $p < 0.001$); and Asia considered itself more active in implementing myopia control strategies (8/10) than Australasia, Europe (7/10), North America (4/10) or South America (5/10). Orthokeratology was perceived to be the most effective method of myopia control, followed by increased time spent outdoors and pharmaceutical approaches. Under-correction and single vision spectacles were perceived to be least effective ($p < 0.05$). Although intra-regional differences existed 67.5% (±37.8%) of practitioners prescribed single vision interventions as the primary type of correction for myopic patients. The main justifications for their reluctance to prescribe anything other than single vision were increased cost (35.6%), inadequate information (33.3%), and the unpredictability of the outcome (28.2%). Regardless of the practitioners' awareness of the relative efficacy of various methods available, the vast majority still prescribe single vision interventions to young myopes. In view of the increasing prevalence of myopia and the existing evidence for interventions to slow myopia progression, clear guidelines for myopia control needs to be established.

Orthokeratology and short term changes in peripheral refraction

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An increase of myopia prevalence is observed worldwide and especially in East-Asian countries. Solutions are sought to reduce the increase in myopia development as myopia can lead to pathological consequences such as retinal detachment and glaucoma. Orthokeratology has been identified as an optical method to control myopia progression. The reasons for this positive effect remain elusive but may be related to changes in peripheral refraction during the course of the day caused by corneal curvature changes. The purpose of this case report is to measure changes in peripheral refraction after orthokeratology lens removal and compare this to changes in an emmetropic subject. Peripheral refraction was measured using an open-field autorefractor in the central 60 degrees for three subjects. Two subjects had worn orthokeratology lenses for more than two months. Measurements were taken once in the morning shortly after removal of the orthokeratology lenses and then repeated again in the late afternoon. One additional subject was emmetropic and did not need any form of optical correction. Measurements were also taken in the morning and in the afternoon. To confirm the findings, the morning and afternoon peripheral refraction measurements have been repeated on a second day. At each eccentricity, three readings were taken and then averaged. Topography measurements were performed in one orthokeratology subject and the emmetropic subject. A considerable change in peripheral refractions between the two measurements was observed in the two orthokeratology subjects. The peripheral refraction of the emmetropic subject underwent minimal changes. The changes in peripheral refraction were in line with the change of topography. Constant changes of defocus levels in the peripheral retina after orthokeratology might be a possible factor in myopia control. Further analysis in a larger population is needed.

Corneal curvature changes using long term orthokeratology

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In short time users of orthokerotologic lenses, effect of the orthokeratology therapy is reversible; the cornea recovers in one week without using contact lenses (Soni, Nguyen, & Bonanno, 2004). Many patients use orthokeratology for a couple of years. And there is a question – how corneal curvature recovers if the long term orthokeratology patient stops treatment? Will there be a complete corneal topographic recovery in one week or there is longer resting time necessary? We analyzed differences in the radius of corneal curvature and differences of the corneal astigmatism using corneal topographies (together 260 topography). There were two age groups – 26 eyes of children and 51 eyes of adults (total 77 eyes). Orthokeratology lenses were used in 3 sections: until 1 year, until 4 years, and until 8 years. We analyzed 5 intermissions of recovery: one week, two weeks, one month, 6 months, and 1 year. There were no statistically significant differences between corneal curvature radius before orthokeratology treatment and the corneal curvature radius after one week resting period ($p = 0.1$). Difference of the corneal astigmatism was 0.50-1.60 D in 28% of all recovery cases. Practically obtained differences in the radius of corneal curvature were similar to theoretically calculated values. The results show that there is a statistically significant positive correlation between time of using orthokeratology and differences of corneal astigmatism in group of adults using lenses up to 8 years period. But there is still question – whether changes in corneal astigmatism are reason of orthokeratology treatment or physiological corneal changes.

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Slope of the accommodative response measured with the retinal brightness method

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Brightness of the retinal reflex varies with the refractive state of an eye. Therefore, it can also be used to measure the accommodative response. Popular objective methods used to measure the accommodation include autorefractometry (Win-Hall, Houser, & Glasser, 2010) and infrared photorefractometry (Roorda, Bobier, & Campbell, 1998). In this study, we used the retinal brightness measurements to calculate the slope of the accommodative response. During the experiment, a subject viewed a red checkerboard pattern the distance of which is varied between 0.25 m and 4 m. Light from an infrared laser enters the eye, and a photodetector measures the amount of light going out of the eye. A calibration curve plotting the amount of light versus known dioptric power is measured be means of a model eye with optical properties close to those of popular mathematical model of the eyes. By comparing the subjects' data and the data of the model eye, the accommodative response and its slope can be calculated. Five subjects were enrolled in the experiment. Two subjects were myopic, one subject was emmetropic, and two subjects were hyperopic. The refractive error wasn't corrected and the accommodative response was calculated as the stimulus power plus the refractive error. The results show that the emmetropic subject and one of the myopic subjects had a slope smaller than that in the hyperopic subjects and in the myopic subject who had worn the correction previously. These results are in agreement with studies relating the slope of the accommodative response to the refractive error (Millodot, 2015). The results also support the finding that adaptation to blur and reduced sensitivity to blur result in reduced accommodative response in myopes (Collins, Buehren, & Iskander, 2006; Rosenfield, Hong, & George, 2004).

Acknowledgements: The study was supported by ESF project No 2013/0021/1DP/1.1.1.2.0/13/APIA/VIAA/001

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ACKNOWLEDGEMENTS

Special thanks to all the volunteers:
Ilona Čehanoviča, Ruslans Dorošenko, Kristīne Dumberga, Linda Eglīte, Elizabete Eldmane, Annija Gulbe, Kristīne Kalniča, Annija Keiša, Egija Kliesmete, Inese Loča, Sabīne Matulēviča, Dārta Nīmane, Anna Pastare, Diāna Pikuļina, Tatjana Pladere, Madara Segliņa, Antons Turko, Jeļena Turlisova, Patrīcija Vendiņa.

Volunteers will be wearing T-shirts with the logo in order to be recognized and provide help and support.

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