SWAET 2012

The Scandinavian Workshop on Applied Eye Tracking

May 2-4, Karolinska Institutet, Stockholm

Karolinska Institutet

S:T ERIKS ÖGON SJUKHUS

Sponsor

Exhibitors

Contents

The 6th Scandinavian Workshop on Applied Eye Tracking

The Scandinavian Workshop on Applied Eye Tracking (SWAET) is an interdisciplinary meeting place for graduate students, researchers, industry, and other people using eye tracking as a measurement tool.

This year, at the 6th SWAET meeting, we are delighted to have Dr. Daniel C. Richardson from University College, London, and Dr. Zoï Kapoula from the European Hospital Georges Pompidou, Paris, as keynote speakers. We are also proud to have 22 speakers and 11 posters at the workshop.

The main themes this year concern eye tracking methodology in general and how eye tracking can be used to learn about language and learning, perception and cognition, visual search in decision making, and viewing behaviors when interpreting medical images.

A new addition to SWAET is the plenary discussion which wraps up this year's meeting. The topic is Academic and Industrial Perspectives on Eye Tracking Standardization; we look forward to a lively debate!

You are all most welcome to Stockholm!

Karolinska Institutet and St. Erik Eye Hospital

Karolinska Institutet is a medical university at the heart of society. We are players in a global arena, also in close collaboration with the health and medical sector and the business community. The strong research profile of Karolinska Institutet places on us a responsibility to take a leading role within the whole field of medical science.

Karolinska Institutet has contributed to improving people’s health for over 200 years – by constantly seeking new knowledge and by educating the health care personnel and researchers of tomorrow. The global health challenges are extensive. But the prerequisites for finding new and better treatments have never been as promising as today. We are subject to high expectations for the future from the community, from present and future students and – not least – from the general public. We intend to fulfil these expectations.

St. Erik Eye Hospital is one of the world's leading eye hospitals and is the only eye hospital in Sweden. St. Erik Eye Hospital is a university hospital with high-quality research and a broad variety of education and training. We offer planned and emergency care.

Program

Wednesday 2 May

16.00 **Eye tracking methods lecture by Kenneth Holmqvist**
Venue: St. Erik Eye Hospital

18:00 **Get-together party**
Venue: The Bernadotte Laboratories

Thursday 3 May

08.30 **Registration**
Venue: Karolinska Institutet

09:00 **Introductions**
Tony Pansell and Gustaf Öqvist Seimyr

09:10 **Keynote**
Eye and thou: Eye movements and social cognition
Daniel C. Richardsson

09:50 **Presentation of exhibitors**

10:10 Coffee / Refreshments
Exhibition

10:40 **Oral presentation session**
Moderator: *Zoï Kapoula*

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Individual differences in speech-driven gaze patterns in the visual world task
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Eye movements to “nothing” have an active role when arrangements of objects are retrieved from memory
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12:00 Lunch

13:00 **Oral presentation session**
Moderator: *Jan Ygge*

Familiarity and preference formation during the choice process
Poja Shams, Erik Wästlund, and Anders Gustafsson

Attention and memory for explicit and implicit print advertisements
Jaana Simola, Sanna Korpela, Markus Kivikangas, and Christina M. Krause

Mobile eye tracking glasses reveal stages of visual search in the supermarket
Arnd Rose and Stefanie Gehrke

Central fixation bias in the real world? Evidence from the supermarket
Kerstin Gidlöf, Kenneth Holmqvist, and Annika Wallin

14:20 Coffee / Refreshments
Exhibition

14:50 **Oral presentation session**
Moderator: *Kenneth Holmqvist*

Top-down and bottom-up influences on viewing behavior in diagnostic radiology
Ellen M. Kok, Anique B. H. de Bruin, Simon G. F. Robben, and Jeroen J. G. van Merriënboer

Eye movement patterns as a reflection of expert behavior in viewing dynamic medical images
Raymond Bertram, Laura Helle, Johanna Kaakinen, and Erkki Svedström

Aquiring, analyzing and visualizing volumetric gaze data from radiologists interpreting chest computed tomography
Martin Tall, Justus Roos, Kingshuk Choudhury, Sandy Napel, and Geoffrey D. Rubin

15:50 Refreshments
Exhibition

16:20 **Oral presentation session**
Moderator: *Gunnar Lennerstrand*

Real-time parallax error compensation in head-mounted eye trackers
Diako Mardanbegi and Dan Witzner Hansen

Accuracy of fast, post-saccadic eye movements recorded with pupil-based eye trackers is influenced by relative motion between the pupil and the iris
Marcus Nyström, Ignace Hooge, and Kenneth Holmqvist

The effect of task difficulty on eye movement sequences in multiple dimensions
Richard Dewhurst, Marcus Nyström, Halszka Jarodzka, Tom Foulsham, Roger Johansson, and Kenneth Holmqvist

17:30 Conference dinner
Venue: Tobii Technology Headquarters

Friday 4 May

08.30 Morning coffee
Venue: Karolinska Institutet

09:00 **Poster presentation session**

Evaluation of user preferences during reading of 2D and 3D cartographic visualizations
Popelka Stanislav, Brychtova Alzbeta, and Jan Brus

Visualisation of elevation information on maps: An eye movement study
Katja Irvankoski, Jari Torniainen, and Christina M. Krause

Neural correlates of oculomotor, low-level and high-level processes during free viewing of natural scenes
Jari Torniainen, Jaana Simola, Kenneth Holmqvist, Jyrki P. Mäkelä, and Christina M. Krause

Relation between motion perception and gaze direction. Evidence from VOG eye tracking
Mariagrazia Benassi, G. Baroni, L. Lugli, R. Bolzani, and R. Nicoletti

Gaze evaluation of the St. Erik Eye Hospital web page
Mårten Angner and Camilla Landin

Text comprehension during noise exposure: Effects on eye movements, galvanic skin responses and subjective performance
Alexander Strukelj, Nils Holmberg, Paulina Lindström, Frans Mossberg, Jonas Brännström, and Kenneth Holmqvist

Translog-II: A program for recording user activity data for empirical reading and writing research
Michael Carl

Othello against Duchenne – Where do we look and how good are we in detecting fake versus real smile
Nina Chrobot, Natalia Jermakow, and Marcin Szulzycki

Viewing emotional images: evidence from simultaneous EEG- and eye movement recording
Mona Moisala, Jaana Simola, Jari Torniainen, Markus Kivikangas, and Christina Krause

Eye tracking interface design for controlling a mobile robot
Muhammad Asghar Jan

SMI eye-tracking device for control of map application by sight
Rostislav Nétek and Jan Brus

10:15 **Keynote**
Saccade vergence eye movements: Development, aging, and dysfunction
Zoï Kapoula

10:55 Quick break

11:00 **Oral presentation session**
Moderator: *David Braze*

Language learning and gaze in text-based interaction
Therese Örnberg Berglund

How a picture can foster comprehension of text: Evidence for scaffolding
Alexander Eitel, Katharina Scheiter, Anne Schüler, Marcus Nyström, and Kenneth Holmqvist

Studying viewing and learning behavior in video with an eye tracker
Jelle de Boer

12:00 Lunch

13:00 **Oral presentation session**

Moderator: *Daniel C. Richardsson*

How do university students solve problems in vector calculus? Evidence from eye tracking
Magnus Ögren and Marcus Nyström

High quality bicycle tracks result in more efficient visual search patterns during cycling
Pieter Vansteenkiste, Greet Cardon, Renaat Philippaerts, and Matthieu Lenoir

The effect of display glare on eye movements when reading
Susanne Glimne, Rune Brautaset, and Gustaf Öqvist Seimyr

14:00 Coffee / Refreshments

Exhibition

14:30 **Plenary discussion**

Academic and Industrial Perspectives on Eye Tracking Standardization

Tobii Technology:
Is this the best system in the world or is it just a tribute? Relating eye tracker specifications with performance
Ricardo Matos

Swedish National Road and Transport Research Institute (VTI):
Issues when using eye tracking in traffic safety research
Christer Ahlström, Tania Dukic, Carina Fors, Katja Kircher, Anna Anund, Christopher Patten, Birgitta Thorslund, Arne Nåbo, Inger Forsberg, and David Sandberg

Communication by Gaze Interaction (COGAIN):
Eye tracker data quality: The international standardization initiative
Fiona Mulvey and Kenneth Holmqvist

16:00 **Concluding remarks**

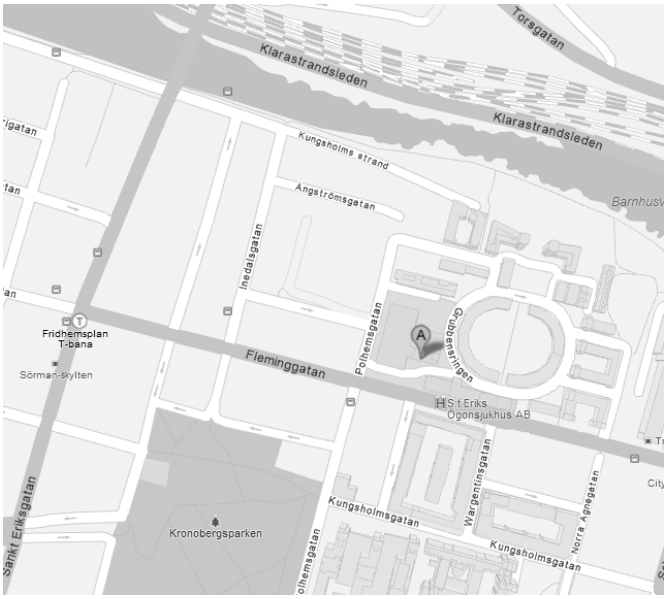
Tony Pansell and Gustaf Öqvist Seimyr

Venues

St. Erik Eye Hospital

The eye tracking methods lecture on Wednesday afternoon will take place in the auditorium at St. Erik Eye Hospital. The hospital is located at Polhemsgatan 50.

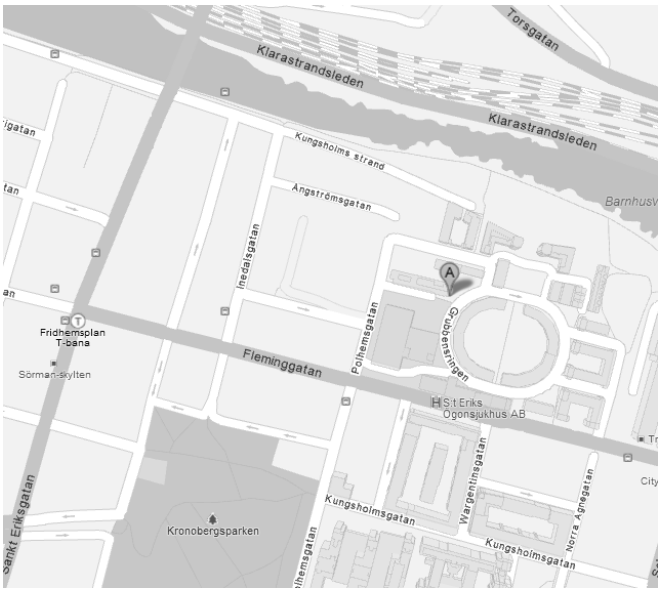
The auditorium is located just by the main entrance. The subway station closest to the hospital is Fridhemsplan, the buses numbered 1, 3, and 4 also stops here. Bus number 1 also has a stop just outside the hospital.



The Bernadotte Laboratories

The get-together party on Wednesday evening will take place at the Bernadotte Laboratories.

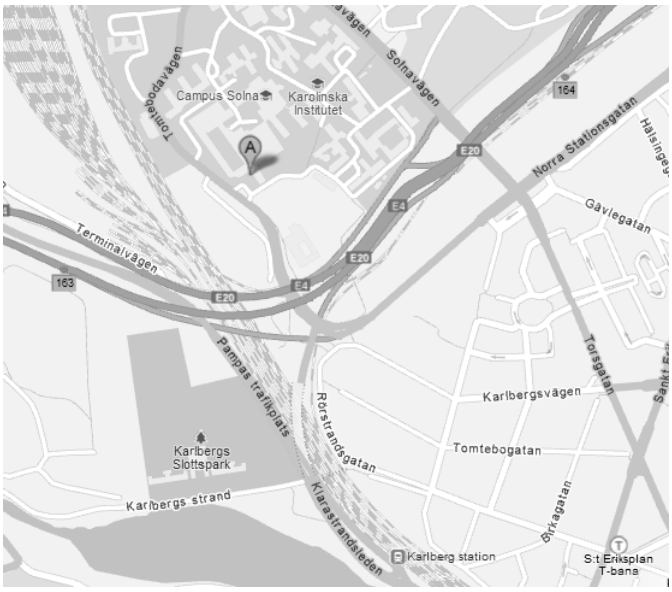
The lab is located at Polhemsgatan 56, just behind St. Erik Eye Hospital. The subway station closest to the hospital is Fridhemsplan, the buses numbered 1, 3, and 4 also stops here. Bus number 1 also has a stop just outside the hospital.



Karolinska Institutet

The plenary sessions on Thursday and Friday will take place in the Gustaf Retzius hall at Karolinska Institutet. The hall is located at Berzelius väg 3 on the main campus in Solna.

The nearest subway station is S:t Eriksplan. From here you can take bus number 4 to Karolinska Institutet. From the central station you can take bus number 76.

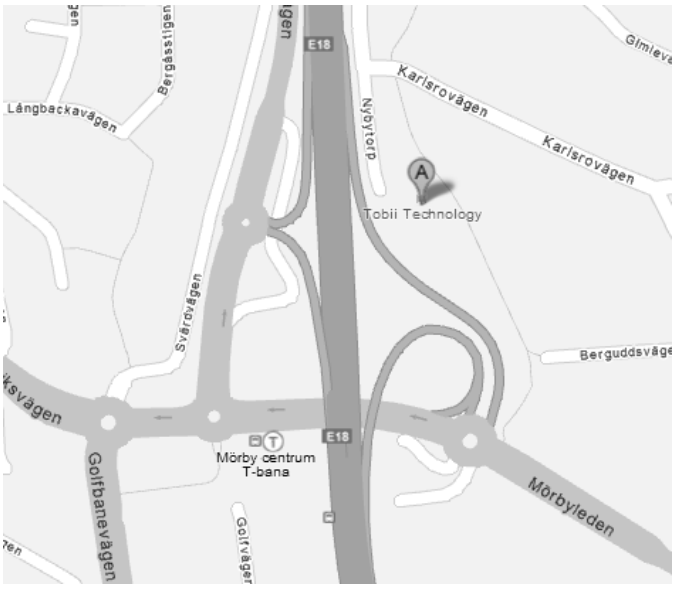


Tobii Technology

The conference dinner on Thursday evening will take place at Tobii Technology Headquarters.

The premises are located at Karlsrovägen 2D in Danderyd, near the Mörby centrum subway station. We will arrange transportation by bus from Karolinska Institutet to Tobii.

To get from Tobii to where you are staying, the easiest way is to take the subway from Mörby centrum.



Keynotes

Daniel C. Richardsson

University College, London

Dr. Richardson has a bachelor degree in psychology from Oxford University and received his PhD at the Cornell University. Dr. Richardson is appointed as a senior lecturer at University College London (UCL). His research focuses on cognition in a social context, in adults and children, in health and disease. He uses gaze and body movements during language, memory and decision making.

Zoï Kapoula

Hôpital Européen Georges Pompidou, Paris

Dr. Kapoula is a research director for the IRIS group at the Hôpital Européen Georges Pompidou, Paris, France. Dr. Kapoulas research focuses on the interaction between vision and postural control, with a special emphasis on development and aging, learning and plasticity effects on oculomotor control. She has published several papers on the topic of binocular control and vergence eye movements. It concerns all eye movements (saccades, pursuit, vergence, fixation, optokinetic nystagmus).

Eye and thou: Eye movements and social cognition

Daniel C. Richardsson
University College, London

Movements of the eye are determined by an interaction of low level properties of the stimulus and high level cognitive factors. Typically in eye movement research, the cognitive factors are that are investigated are expectations or schemas for particular types of scene. I will present three projects demonstrating that social factors also have a substantial contribution to eye movements. In the first, participants watched a video of people giving their views on a sensitive political issue. One speaker made a potentially offensive remark. If participants believed these remarks could be heard by others, they fixated individuals who were likely to be offended. In a second study, two participants in adjacent cubicles had a discussion over an intercom while they were eye tracked. We found that their gaze coordination was modulated by what each believed the other could see on the computer screen. In the final set of experiments, we simply showed groups of four stimuli to pairs of participants. We found that that individuals looked at photographs differently if they believed that the other person was looking at the same images as them rather than a set of random symbols. Together these experiments demonstrate that social forces have a strong effect on perceptual mechanisms. Gaze patterns are determined by what we think others will feel, what we think our conversation partners can see, and simply whether or not we think we are looking alone or with other people.

Saccade vergence eye movements: Development, aging, and dysfunction

Zoï Kapoula
Hôpital Européen Georges Pompidou, Paris

Eye movements are essential for vision and perception but also forinvestigating brain function, cognition and cerebral plasticity. After a brief presentation of the entire repertoire of eye movements and the techniques for measuring eye movements, I will focus on two types ofeye movements: saccades and vergence, their latency-accuracy-speed and binocular coordination. I will report our research on these aspects in children, adults and aged persons. I will also present our findings on deficits of vergence eye movements and of binocular control in dyslexia, strabismus, vertigo and tinnitus. Finally I will report the interest of eye movements in exploring cognitive impairment in Alzheimer's disease.

Plenary discussion

Is this the best system in the world or is it just a tribute? Relating eye tracker specifications with performance

Ricardo Matos
Training & Education Department, Tobii Technology

Ever since remote eye trackers started to appear on the market, manufacturers have looked for ways to measure and report eye tracker technical specifications that could be used to describe their performance. However, this process was done independently by each manufacturer and no standards have yet been established. Consequently, the technical specifications for eye trackers are often difficult to compare, with each manufacturer providing a value that describes a specific attribute without clearly defining it, nor stating the methodology used to measure it.

The goal of this talk is to examine closely the accuracy and precision specifications of an eye tracker manufacturer (Tobii Technology AB). The rational of the test method behind these specifications is to provide a standardized method to measure different remote eye tracker models, in different user relevant scenarios. The method tests a variety of factors that affect the eye tracker performance, such as the test room lighting conditions, head position in the track box and stimulus angle placement on the screen. Precision is also measured on artificial eyes in order to differentiate between system noise and expected precision on human eyes, with human artifacts included. Accuracy and precision are calculated from stable eye tracking data (high track robustness individuals). This latest test requirement has an important effect on the way the eye tracker specifications should be interpreted and extrapolated to other eye tracking setups.

I will finish this talk by briefly discussing future improvements and changes to this method as well as the inclusion of other important eye tracking metrics.

Issues when using eye tracking in traffic safety research

Christer Ahlström, Tania Dukic, Carina Fors, Katja Kircher, Anna Anund, Christopher Patten, Birgitta Thorslund, Arne Nåbo, Inger Forsberg, and David Sandberg

Swedish National Road and Transport Research Institute (VTI), Linköping, Sweden

Driving is to a large extent a visual task and safe driving demands active visual search for traffic relevant information. Despite this fact, an increasing amount of potentially distracting objects are continuously being added to the driving environment; advanced driving assistance systems, navigation systems, smart phones, billboards along the roads and so on. From a human factors perspective, this development has brought forward eye tracking as one of the most important tools in traffic safety research. The objective of this presentation is to provide a bird's eye view on how eye tracking is used in traffic safety research and, above all, to highlight many of the difficulties we have encountered in our daily work.

In naturalistic settings where eye tracking is used from hours to months of driving without any manual recalibration, one is often surprised of how bad the tracking quality is. Tracking is lost for no apparent reason, the left and the right eyes diverge in unpredictable ways, slowly varying baseline drifts of 10 – 20 degrees are present, and the uptime of the tracker is low. When compared to some ground truth, only a fraction of eye blinks are detected, and accuracy, precision and availability deteriorates quickly when the gaze targets are moved to the periphery. Some eye tracking equipment has problems with sunlight, others with the large pupil size that arise at night-time – not to mention alternating lighting conditions such as when driving under a bridge. Problems also arise due to mascara, clothing or certain types of glasses. Remote eye trackers typically have problems with the cameras' field of view and there is usually no way of knowing if lost tracking is due to tracking failure, or because the head is outside the head box.

As a wish list for the eye tracker developers, we would like to see systems that are able to deal with quickly changing lighting conditions (including strong sunlight) as well as mascara and glasses. We would also well-functioning auto-calibration including driver identification. On the top of our list though, we would like to have better control over the lost tracking episodes. If we knew which sequences of lost tracking that were due to extreme gaze angles, the data sets would be so much more useful.

Eye tracker data quality: The international standardization initiative

Fiona Mulvey and Kenneth Holmqvist
Lund University, Communication by Gaze Interaction (COGAIN)

To date, there is a complete lack of a standard methodology for measuring and quantifying eye data quality. We argue that the lack of standard measures makes several aspects of manufacturing and using eye-trackers, as well as researching eye movements and vision, more difficult than necessary. The terminology across different research fields and eye-tracker manufacturers varies and---although certain data quality terms are used widely in the literature---it is often difficult for the user to know what exactly these terms refer to. The eye-tracking community would benefit from a standardized methodology that offers clear and transparent definitions of the central terms. This is the purpose of the COGAIN technical committee for the standardization of eye data quality measures. In our talk, we illustrate why data quality matters with examples, and review previous work on how it has been measured and reported, and finally describe how the standardization committee plan to carry out its work.

Oral presentations

Do as eye say: the interaction between gaze cues and language specificity in social interaction

Ross G. Macdonald and Benjamin W. Tatler
University of Dundee, UK

Gaze cues are important in communication and are used in this way even before spoken language has developed. Once language has been mastered, these cues continue to be used in social interactions. Most gaze cues will not be given in isolation; they will be given and followed within the context of a natural dialogue. Despite this, most previous research on gaze cueing has used paradigms without spoken language. As well as focusing on gaze independently of language, previous paradigms have often been highly artificial, using stimuli that are far removed from real-world gaze cues.

The present study uses authentic gaze-cues to investigate the interaction between gaze and language in the real-world by measuring three aspects of gaze utilisation: gaze seeking, gaze following and behavioural benefits. Each participant followed instructions to build a series of abstract structures out of building blocks. Throughout the experiment their eye movements were recorded using a Positive Science LLC mobile eye-tracker, which allowed free head movement. In a 2x2 between-subjects design, the instructor varied the specificity of the instructions given to participants (unambiguous or ambiguous language) as well as the presence of beneficial gaze cues (present or absent). Eye tracking data were coded offline and fixations to the blocks were recorded along with task performance. We measured three dependent variables: (1) percentage of instructions in which the participant looked at the instructor, (2) percentage of first fixations after the first descriptor word on the target block and (3) percentage of correct pick-ups of the target block. When ambiguous instructions were used, participants looked at the instructor more, made more correct first fixations and made more correct pick-ups when gaze cues were given than when they were not. For those given unambiguous instructions, the presence or absence of gaze cues did not significantly affect any of the measures.

Our findings provide new theoretical insights into when and how we use the gaze cues supplied to us by people with whom we interact. These results indicate that rather than being a ubiquitous response to a social interaction, the tendency to engage in gaze seeking and following depends on the informativeness of the gaze cue relative to other available information. In the case of this experiment, when language provides necessary information to locate a block, gaze cues are not sought nor followed. Similarly, if the instructor's gaze is not informative, these cues will not be sought out, even if the spoken language does not provide sufficient information to locate the block. By innovatively combining language and gaze cues experimentally in an ecologically valid environment, we are able to conclude that people only utilise the gaze cues of others when the cues provide useful information.

Individual differences in speech-driven gaze patterns in the visual world task

David Braze, Anuenue Kukona, Whitney Tabor, James Magnuson, Einar Mencl, Sergey Kornilov, Julie A. Van Dyke, Clinton Johns, and Donald Shankweiler
Haskins Laboratories, Yale University, Connecticut, USA

Eye movements over visual displays during apprehension of speech yield sensitive indicators of the time-course of speech comprehension [1]. On a moment-by-moment basis, gaze to display elements is closely connected to the meaning of the language being heard. This 'visual world' (VW) paradigm has been used to study various aspects of speech perception and comprehension ranging from phonetic characteristics of speech [2], to semantic characteristics of words [3], to integration of meaning across words [4]. However, the bulk of research using the VW task has focused on contingencies between variation in gaze responses and variation in stimulus characteristics. Our interest is different, lying not in the nomothetic effects of stimulus manipulations, but in individual variability around the nominal responses.

We use the VW task to examine associations between the ability to integrate semantic information across words and visual context, and individual differences in measures of language and literacy skill. We recruited native English speakers with wide-ranging literacy skills aged 16 to 24 years (n=64) from adult education centers and community colleges serving urban neighborhoods. Thus, we capture a wider range of language-related capacities than found among university students. We seek to achieve a deeper understanding of the true range of variation in human language processing skill and its correlates [5]. Participants were assessed for vocabulary knowledge, verbal memory and other measures of language and cognitive function.

Our VW task consists of a 4 picture display and a simple instruction to the participant to (e.g.) "Point to the purple balloons." Four conditions instantiate factorial manipulation of 2 variables: First is early vs. late resolution: in the 'early' condition targets can be identified by color alone (only 1 purple object onscreen); targets in the 'late' condition cannot be identified until the noun is heard (more than 1 purple object onscreen). The second factor is the presence vs. absence of a name competitor for the target. Competitor displays include an object of the same type as the target, but of a different color; in other displays the target picture is unique with respect to name (cf. [4]). Adjectives are common color terms and nouns are names of common objects.

Analyses use mixed-effects growth models to examine the proportion of looks to target pictures in each condition as a function of time [6]. We find associations between measures of verbal memory, visuo-spatial memory and vocabulary knowledge and the time course of gaze to target objects. This study demonstrates the existence of non-random variation in the ability of adult listeners to integrate meaning across words and with visual context, even in the case of simple adjective--noun composition.

References:

1. R. M. Cooper, *Cognitive Psychology* 6, 84 (1974).
2. D. Dahan, J. S. Magnuson, M. K. Tanenhaus, E. M. Hogan, *Language and Cognitive Processes* 16, 507 (2001).
3. Mirman, T. J. Strauss, J. A. Dixon, J. S. Magnuson, *Cognitive Science* 34, 161 (2010).
4. J. C. Sedivy, M. K. Tanenhaus, C. G. Chambers, G. N. Carlson, *Cognition* 71, 109 (1999).
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6. M. Bates. (University of Wisconson, Madison 2010).

Shedding light on the functionality of the looking at nothing-phenomenon for memory retrieval

Agnes Scholz, Katja Mehlhorn *, and Josef F. Krems
Chemnitz University of Technology * Carnegie Mellon University

People fixate on blank locations if task irrelevant visual stimuli previously occupied that region of space. This so-called 'looking at nothing' phenomenon has been associated to information retrieval from an integrated memory representation. Although, it has been found that looking at nothing increases accuracy of memory retrieval for visual information (Ferreira, Apel, & Henderson, 2008), it is unclear whether it also affects the retrieval of auditory information from memory (Richardson, Altmann, Spivey, & Hoover, 2009). To test the relation between gaze behaviour and memory retrieval of auditory information, two experiments were conducted. In Experiment 1, participants listened to four sentences, each associated to one of four areas on the screen. Subsequently, they had to verify an auditorily presented statement about one of the sentences, by retrieving the related information from memory. During the retrieval phase, they could gaze freely. Eye fixations were recorded throughout the experiment with a remote eye tracker sampling gaze data of the right eye at a rate of 50Hz. As predicted, participants fixated proportionally more often towards the spatial area that was associated to the auditory information then to one of the irrelevant locations. When participants answered correctly, they showed looking at nothing behaviour. However, when they gave a wrong answer, looking at nothing behaviour could not be observed. These findings suggest that eye movement towards emptied spatial areas are part of information retrieval from memory for auditory information.

In Experiment 2 we went one step further and investigated whether there is a causal link between gaze behaviour and retrieval performance. Therefore, eye-movements were manipulated as the independent variable. Participants followed the same procedure as in Experiment 1 with the one difference that during retrieval, participants could either gaze freely, or had to look at a fixation cross that appeared in the area associated to the tested sentence or in one of the other three areas. This manipulation of eye movements significantly affected retrieval performance: When participants gaze was guided away from the relevant location, retrieval performance decreased in comparison to when they were allowed to gaze freely. When gaze behaviour was guided towards the relevant location, retrieval performance did not increase in comparison to the free gaze condition.

Our results suggest that looking at nothing behaviour does affect memory retrieval of auditory information and therefore support the assumption of looking at nothing as a consequence of an internally stored memory representation. However, indexing towards the emptied location does not serve as an additional retrieval cue for auditory information.

References:

1. Ferreira, F., Apel, J., & Henderson, J.M. (2008). Taking a new look at looking at nothing. *Trends in Cognitive Science*, 12(11), 405-410.
2. Richardson, D.C., Altmann, G.T.M., Spivey, M.J., & Hoover, M.A. (2009). Much ado about eye movements to nothing: a response to Ferreira et al.: Taking a new look at looking at nothing. *Trends in Cognitive Science*, 13(6), 235-236.

Eye movements to “nothing” have an active role when arrangements of objects are retrieved from memory

Roger Johansson *, Mikael Johansson **, Jana Holsanova *, Richard Dewhurst *, and Kenneth Holmqvist *****

* Department of Cognitive Science, Lund University ** Department of Psychology, Lund University *** Humanities Laboratory, Lund University

Several studies have reported that spontaneous eye movements occur with visual imagery and that they closely reflect content and spatial relations from an original picture or scene (e.g., Brandt & Stark, 1997; Spivey & Geng, 2001; Johansson, Holsanova, & Holmqvist, 2006). Nevertheless, the exact purpose of these eye movements to “nothing” is elusive and has currently been the target of a hot topic of debate (cf., Ferreira et al., 2008; Richardson et al., 2009). Do they have an active and functional role when visuospatial memories are retrieved or are they merely an epiphenomenon? In a recent study we reported that when eye movements were prohibited for participants who orally described pictures from memory, their recollections became altered and impaired (Johansson, Holsanova, Dewhurst, & Holmqvist, 2011). The current study was designed as a follow-up, with the purpose to uncover exactly how imposing different eye movements on participants affect memory retrieval of visuospatial memories.

Eye movements were recorded – using a SMI RED 500-system – from 16 participants during an experiment where sets of objects were visually encoded and subsequently retrieved from memory. In the encoding phase, the participants encoded 24 objects in different locations on a computer screen. In the retrieval phase, they listened to pre-recorded spoken statements that either dealt with a property of an object – intra-object – or with the spatial arrangement between two objects – inter-object. The participants were instructed to orally decide whether those statements were true (by saying ‘yes’) or false (by saying ‘no’). The retrieval phase was divided into blocks of four different conditions: (1) free viewing on a blank screen; (2) gazing at a fixation cross; (3) looking at an area which was matched with the original location of the object(s) to be recalled; (4) looking at an area which did not match the original location of the object(s) to be recalled. Over the entire experiment each participant responded to 192 statements.

The data was analyzed within-subjects over the four conditions in respect to reaction time (RT) for correct responses. The eye movement data was used to verify if the participants were able to comply in the conditions when they were restricted to look at the fixation cross or inside the matched/non-matched area. If not, those trials were excluded.

Results revealed a significant main effect for RT in regard to inter-object statements but not for intra-object statements. Post-hoc comparisons revealed that looking at the fixation cross and looking at the area which did not match the original location of the objects to be retrieved yielded significantly longer RT when compared to free viewing and looking at the area which matched the original location of the objects to be retrieved.

Consequently, these results demonstrate that eye movements to “nothing” do indeed have an active and supportive role when visuospatial information is retrieved from memory and show that those eye movements primarily influence processes that integrate spatial properties between objects.

Familiarity and preference formation during the choice process

Poja Shams, Erik Wästlund, and Anders Gustafsson
Karlstad university, Service Research Center

Researchers have elaborated on the mechanisms that influence decision-making and the role of heuristics, visual attention and preference in decision-making. To get insight into these mechanisms that lacks conscious access or control {{369 Wedel, M. 2007;}} in complex decision-making, we applied process tracing method that has been advocated by previous researchers {{290 Payne,John W. 1976; 300 Olshavsky,Richard W. 1979}}. The fundamental standpoint of the present paper is that consumer's use familiarity and preference at different stages of decision-making and this is based on the research done on staged decision-making and the use of heuristics in the decision-making process. Furthermore, decisions for consumer goods are often complex because of the number of alternatives that are represented in each product category and it is believed that preferences are constructed rather than retrieved in complex decision-making. However, memory plays a crucial role in preference and choice and not much is known about the relationship between memory processes, such as familiarity, and preference formation {{605 Weber, E. 2006}}. Thus, we assume that preferences are both retrieved and constructed by the participants in the present paper.

One hundred and twenty-eight Arizona State University undergraduates partook in the study (51 percent females; 64 percent did regular shopping for household). The participants were recruited from campus during a five day period and given 10USD compensation for their participation in the study.

The study design was such that all participants were exposed to two digital images of shelves containing two different product categories (Coffee/Dishwashing liquid). Each trial started with a brief description of the study and a calibration of the eye-tracking apparatus. A series of 3 shelf images were shown to each participant, the first image being a familiarizing task image and then the 2 subsequent shelf images, coffee and dishwashing liquid. Breakfast cereal was used as a familiarizing image in order for the participants to be accustomed to the procedure of the trial before the stimulus images was presented. The two shelf images were combined with a choice task and given before each image was shown the participants. The search task was "please choose a product that you would like to buy", as if they were about to do so in a store.

The focus of the analyses is the gaze behavior, measured in terms of observation duration and observation count, during the consumer choice process. The results of our study shed light on the interaction between of preferences based on product familiarity and preference formation taking place during the choice process.

Attention and memory for explicit and implicit print advertisements

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Advertisers try to increase ad originality to break through the information clutter due to rising levels of advertising competition. One way to increase ad originality is to make the ad message less explicit in order to increase consumers' elaboration of the ad message. The present study investigates processing of two types of print advertisements: explicit and implicit advertisements. In explicit advertisements, the picture and the text are directly related to the advertised product or brand. In implicit advertisements, the picture and the text are in a more complex relation to each other, and the advertised product is not presented in a straightforward manner.

Eye movements were recorded from 41 participants during free viewing of 20 explicit and 20 implicit advertisements for 5 seconds. Categorization of advertisements into explicit and implicit groups was based on a preliminary study where 5 participants (not part of the actual sample) rated the ads on a scale from 1 to 9, whether they considered an ad as explicit or implicit. The explicit and implicit ads did not differ in their low-level featural information. Ad processing was studied in terms of eye fixation measures (number of fixations, time to first fixation, total gaze duration and mean fixation duration) on the key elements of the advertisements – product, brand, text and pictorial – and how the information extracted during initial viewing transforms into memory, preference and purchase intention for the brands. Memory performance and preference ratings were collected on the next day from the initial exposure to the ads.

The results showed that the product information was fixated more often and for longer time in the explicit than in the implicit condition, but the mean fixation duration on the product information was longer in the implicit condition. The number of fixations on the brand logos was higher in the explicit condition. The text information was fixated for longer time and the mean fixation duration on the text was longer for the implicit than for the explicit ads. In addition, the ad pictorials were fixated more frequently and for longer durations in the implicit condition, and the memory and preference scores for brands were higher for the implicit than for the explicit ads.

The results indicate that the implicit ads produced higher number of fixations and longer gaze durations on the ad pictorials and texts than the explicit ads. Moreover, increased attention to the implicit ads transformed into higher memory and preference scores for the brands of the implicit ads as compared to the explicit ads. Thus, the results suggest that increasing consumers' processing of the ad message leads into increased attention, memory and preference for the implicit advertisements.

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Mobile eye tracking glasses reveal stages of visual search in the supermarket

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Goals and Objectives - SensoMotoric Instruments (SMI) and HIPP, a leading German brand for baby diets, conducted a supermarket study using SMI Eye Tracking Glasses to examine visual search strategies of shoppers in a supermarket. The objective of the study was to assess implicit factors which influence orientation and decision-making in a real-world environment. The final goal was to use the data on visual orientation of parents to decide for the best option to display the new HIPP product category “1 to 3 years”.

Methods Used - The mobile glasses-type eye tracker from SMI was used to record the eye gaze of shoppers looking at a target shelf in order to obtain objective data on visual search: from the first orientation at the shelf until the final buying decision. The study was conducted in 2011 in three supermarkets in Germany, each representing one out of three different shelf layouts. All supermarkets were similar in demographic distribution of consumers, size and product portfolio. 35 participants were asked to buy a dedicated HIPP product of the category “1 to 3 years” for each of three items on a shopping list. Their eye gaze was recorded with the SMI Eye Tracking Glasses. In a post-hoc interview they were asked for a subjective evaluation of their shopper experience. Eye Tracking Measures Used - For analysis, the time to see a product (time to first fixation) and the time to identify the product (time to take the product out of the shelf) was compared for the three product items and the three shelf layouts. The objective results were correlated with the subjective shopper experience (how easy it was to find the products). Did a better experience (6= best result) correlate with lower search time?

Main outcome - The study shows a correlation between visual search time until seeing a product and identifying it. The time until the first fixation on the target product (“seeing it”) predicts how long it takes parents to verify the decision and take it from the shelf (“identifying it”) with high significance. Nevertheless, for some products, e.g. the “drink” in this study, there was a larger gap between seeing the product (time to first fixation) and identifying it (taking it from the shelf). This might suggest necessary improvements in package design to enable shoppers to identify the product more easily. Based on the comparison data for the three different shelf layouts, one shelf layout outperformed the other two options. Shelf layout 1 generated the lowest visual search time until identifying all three product items (deciding which products to take from the shelf). Consumers also allocated the best subjective rating to this shelf layout.

Significance -This study used eye tracking to study visual search strategies at the POS and to reveal implicit factors which influence orientation and decision-making in a real-world environment. Eye tracking data helped to decide for the best way to integrate the new product category into existing shelf layouts and to communicate those recommendations to the retail markets.

Central fixation bias in the real world? Evidence from the supermarket

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In the last decade, the use of eye tracking in visual marketing and consumer choice studies has rapidly increased (see Wedel and Pieters 2008 for a review). The majority of these consumer studies are performed in laboratories with products presented on a monitor (Wedel and Pieters, 2008) or as projections (Tonkin, Ouzts and Duchowski, 2011). The findings in these settings are often generalized to more natural environments but before this can be done, there are several issues to be considered. The central bias is one of them.

It has been shown that when presented with a naturalistic scene on a computer monitor, viewers tend to look in the centre of the screen. This central bias occurs irrespectively of both the task and the distribution of features in the scenes (Tatler, 2007). The central bias has mostly been investigated in scene viewing and visual search studies. The question that we want to address in this study is whether these findings are restricted to only the computer screen or if they can be translated to naturalistic settings with stimuli presented within a frame such as a product shelf in the supermarket? We also address the temporal aspect of this bias and whether it is more pronounced in early stages of the process.

We investigated the central bias in a naturalistic environment by studying the visual behaviour of consumers making decisions in a supermarket. 20 consumers were recruited in a supermarket and were fitted with the SMI Eye Tracking Glasses, recording binocularly at 30Hz. Participants were asked to select a fruit syrup that they would consider buying. This was done during their regular shopping. Both the original and a reorganized setup of the shelf was used. The reorganization was made so that the products in the middle of the shelf was moved as far out as possible. This was done to ensure that the distribution of fixations in the scene did not depend on the setup of the shelf and the placement of the most popular products.

The results did not show a clear central bias tendency of the consumers visual attention to the product shelf. Interestingly, the placement of the products had only minor effect on consumers visual attention to them. These results are an interesting contrast to earlier monitor studies clearly showing a central fixation bias. The question is how these results could be generalized to naturalistic settings and in what kind of situations this bias would occur. The results from this study show that the central bias tendency is not that robust in naturalistic setting. Static pictures have several shortcomings compared to real world environments. In real supermarkets consumers can move around and may place themselves so that the most interesting features of the environment are placed at the centre of their visual field. These environments also force people to move around since it is often difficult to look at the whole shelf and examine all products from a single viewpoint. These results are important for the interpretation of data from visual search and scene perception studies in general and consumer decision making studies performed on computer monitors specifically.

Top-down and bottom-up influences on viewing behavior in diagnostic radiology

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Goals and objective - Eye tracking is commonly used for investigating expertise differences in radiology (Krupinski, 2010). Most expertise research focuses on detection of nodules (small, inconspicuous abnormalities) but also other types of diseases might be present in radiological images such as chest radiographs. Three types of images were compared, showing: (a) a focal disease (abnormality at a specific location), (b) a diffuse disease (involves all lobes of both lungs), and (c) no abnormalities (normal images). We investigated the eye movements of experts, intermediates, and novices on those images. It is known that eye movements, which reflect deployment of attention, can be influenced by bottom-up effects which result, for example, from the type of image, and top-down effects which result, for example, from the expertise of the viewer. Bottom-up and top-down effects interact and, together, they 'guide' attention. This interaction is commonly neglected in expertise research, but the current study investigates the interaction between the type of disease and expertise on eye movements.

Methods - Eleven sixth-year medical students (novices), ten residents (intermediates), and nine radiologists (experts) inspected 24 chest radiographs (8 focal, 8 diffuse, 8 normal images) and orally provided a diagnosis while their eye movements were recorded.

Eye tracking measures - An Eyelink 1000 remote eye tracker was used. A global/local ratio was computed by dividing the number of long saccades (> 1.6 degrees of visual angle) by the number of short saccades (< 1.6 degrees of visual angle) (Zangemeister, Sherman, & Stark, 1995). A higher ratio reflects more dispersed looking, while a lower ratio reflects looking at specific regions. Multilevel analysis was used to analyze this global/local ratio and the average fixation duration.

Main outcomes and significance - On average fixation duration, multilevel analysis showed a significant effect of type of image, $F(2, 23.3) = 9.2$, $p < .001$; a significant interaction effect of type of image and expertise, $F(4, 659.1) = 5.17$, $p = .001$, but no significant effect of expertise, $F(2, 30.0) = 1.12$, $p = .34$. On the global/local ratio, we found a main effect of type of image, $F(2, 23.6) = 4.74$, $p = 0.02$, and significant interaction of image type with expertise, $F(4, 651.2) = 4.72$, $p = 0.001$. No significant effect of expertise was found, $F(2, 30.0) = 0.44$, $p = .65$. Type of images strongly influenced participants' eye movements on radiological images. Regardless of expertise, in focal images participants looked relatively long at specific locations, while in diffuse images, relatively short, dispersed looking took place. For normal images, an expertise effect is visible: students looked more dispersed on diffuse compared to normal images, while residents and radiologists looked most dispersed on normal images. In conclusion, viewing behavior differences between experts and novices are relatively small on disease images but larger on normal images. However, students' diagnostic accuracy on normal images is quite high, while for disease images, their accuracy is very low. Models of expertise effects on eye movements should take into account effects of image type.

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Eye movement patterns as a reflection of expert behavior in viewing dynamic medical images

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The present eye movement study investigated the role of professional experience in viewing dynamic scenes and the impact of presentation speed on diagnostic accuracy. The dynamic scenes were 9 videos of CT-scans from (the upper to the lower part of) the abdomen each consisting of approximately 700 multislice stack-view images. Three of the videos included enlarged lymph glands, three other pathologies, and three did not contain any abnormalities. An expert radiologist and a relative novice subject group of radiograph nurses were instructed to detect enlarged lymph glands in the CT-scans while their eye movements were registered. The radiologists were presumed to have better refined visual skills in detecting enlarged lymph glands due to their professional experience. The CT-scans were presented with a frame rate of 7, 14 or 28 frames per second. All participants indicated 7 frames per second to be too slow and detection success was also slightly worse in this than in other conditions.

The results also showed that the radiologists more often detected the enlarged lymph glands than the radiographers did. The difference in success rate was associated with shorter average fixation durations for experts. This finding is in line with the theory of long-term working memory of Ericsson and Kintsch (1995), which proclaims that experts encode and retrieve information more rapidly than novices. The holistic model of image perception (Kundel et al., 2007) holds that experts have a more extensive perceptual span than novices allowing them to extract more information during a single fixation. This would predict them to make longer saccades than novices, but instead the average saccade length was slightly longer for novices than for experts. This suggests that radiologists perform the task actually more carefully than radiographers, a view supported by generally wider pupil dilation for the former group.

Acquiring, analyzing and visualizing volumetric gaze data from radiologists interpreting chest computed tomography

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Purpose
Previous studies investigating eye movements of radiologist during their image analysis have recorded gaze data on single images containing one or more objects, e.g., nodules in a CT scan. Typically the images are displayed for a fixed duration and the results are illustrated through aggregated visualizations e.g., fixation plotting, scan paths or heat maps. However, when analyzing search patterns while performing standard interpretation of volumetric chest CT data, paging through a stack of transverse sections warrants three-dimensional analysis of eye movements. To our knowledge this has not been studied.

Materials and Methods
Our solution for recording volumetric gaze data, using a remote corneal reflection system, relies on two-way communication between the eye tracker and our custom DICOM viewer. This enables real-time mapping between on-screen fixations and the 3D DICOM coordinates of the viewed images at a rate of 50 Hz, thereby linking our eye tracker data and the physical space in which the 3D image data were obtained.

Results
Our approach to tracking and visualizing gaze data recordings within the acquired volumetric space utilizes the DICOM coordinate system for rendering graphics in 3D space. It produces several interesting visualizations, such as time-stamped 3D gaze paths, and 3D heat maps revealing direct and foveal dwell time per voxel, all fused with the acquired volume data for simultaneous viewing.

Conclusions
Our approach offers insight into the relationship between recorded gaze data and the volumetric space of the viewed medical images. We are employing it in an investigation of how paging through volumetric lung CT data affects nodule detection though pop-out feature detection in the peripheral visual field. More generally it will facilitate studies across a wide variety of 3D modalities and illuminate specific aspects of volumetric inspection that can be used for training and diagnostic support.

Real-time parallax error compensation in head-mounted eye trackers

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A common problem of monocular head-mounted eye trackers is that they introduce gaze estimation errors when the distance between the point of regard and the user is different than when the system was calibrated. This error is due to the scene camera and the eye are not co-axial (a.k.a. parallax error). The standard method to compensate for parallax errors is to assume that all working planes are located on a finite set of distances and then perform calibration for each of these planes for each user. This requires that the distance for each fronto-parallel working plane should be set manually before gaze estimation. The approach is therefore most appropriate for offline gaze analysis. Another assumption is that the working plane should be fronto-parallel with respect to the scene camera, and therefore there will be errors introduced when planes are viewed from different angles.

A method for automatic and real time compensation for parallax error in monocular head-mounted eye trackers is presented which can be used when the PoR is in a plane in 3D environment (fixation plane). The method employs a user specific calibration at different depths to learn the depth compensation parameters and the error behavior. Next time that the system is used, the error of the PoR can be interpolated and compensated for by having the depth of the plane that user is looking. Scene depths can be obtained in real-time using calibrated scene camera. The relationship between the camera and the world coordinate systems can be shown by x=(X.f):Z, where x is a point in the image plane, X is a point in the world coordinates system, f is the focal length of camera and Z is the distance of the point from the camera (depth). Z can be obtained for any point on the fixation plane by having three known points in the fixation plane and detecting the corresponding points in the image. Interaction with displays [Mardanbegi and Witzner 2011] is one of the applications in which this method can be used. When the size of the display is known and user is looking at the display (PoR is inside the display plane), depth and subsequently parallax error can be estimated. So the error can be compensated for when user is looking at the display from different distances and angles.

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Accuracy of fast, post-saccadic eye movements recorded with pupil-based eye trackers is influenced by relative motion between the pupil and the iris

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To be able to accurately measure saccade offsets and fixation onsets is important when, e.g., calculating fixation durations, saccade amplitudes, and when controlling the stimulus presentation in a gaze-contingent experiment (Nyström & Holmqvist, 2010). A complicating factor when deciding where the saccade ends is a type of post-saccadic eye movement known as dynamic overshoot, which can be described as a oscillation in the eye-tracker signal that occurs directly after a saccade (Bahill et al., 1975). In data recorded with dual Purkinje (DPIs) eye-trackers, which contain large post-saccadic oscillations, dynamic overshoot has been attributed to motion of the lens relative to the eyeball (Deubel & Bridgeman, 1995). In contract, data recorded with scleral search coils contain smaller or no overshoots, which may reflect that coils modify the neural command signals that control saccades, or that the annulus of the coil slips in relation to the cornea (Frens & van der Geest, 2002). While dynamic overshoot can be found in data recorded with different techniques and across different participants, little is known of why they occur in data recorded from modern video-based eye trackers using the principle of pupil and corneal reflection tracking.

We collected eye movements from three participants making horizontal, abducting saccades from the right side of a computer monitor to its center. Eye movement data and eye images were recorded monocularly from the participants' left eyes at 500 Hz with the SMI Hi-Speed system. The movement of the pupil- and iris centers were extracted from the sequence of eye images and compared with the recorded eye movement data.

Results showed a high correlation between the eye movement data and the motion of the pupil center extracted from the eye image. There was however a large discrepancy between the movements of the pupil- and iris centers during the post-saccadic oscillation. This suggests that the pupil moves relative to the iris, and that this relative motion is reflected in the eye movement data. Consequently, pupil-based eye trackers do not accurately measure post-saccadic eyeball rotation, but rather a superimposed movement consisting of eyeball- and pupil motion (and possibly motion of the iris). These results are important for researchers using pupil-based eye trackers to answer fine-grained questions about the oculomotor system, in particular directly after saccade endings.

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The effect of task difficulty on eye movement sequences in multiple dimensions

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There are several reasons why eye movement researchers are interested in quantifying the effect of task difficulty on scanpaths. First, this allows us to gauge the suitability of educational software; if the implementation is too hard, what kinds of eye movement sequences are associated? Second, the task can be difficult for different reasons, some higher-level (cognitive) some lower (visual); understanding the relationship between these allows us disambiguate top-down from bottom-up influences on the oculomotor system (e.g. Foulsham, Barton, Kingstone, Dewhurst , and Underwood, 2011). Until recently however, studying the effect of task difficulty on eye movements has been limited either to unitary eye movement events (fixations and saccades in isolation (Wertheim, Hooge, Krikke, and Johnson, 2006)), or coarse averaging across many eye movement types (with attention maps (Grindinger, Duchowski, and Sawyer, 2010), and transition matrices (Holmqvist, Holsanova, Barthelson, and Lundqvist, 2003)). Here we present new data showing the effect of task difficulty on scanpaths as measured by our multidimensional scanpath similarity approach (Jarodzka, Nyström, and Holmqvist, 2010). This has the advantage of capturing sequence information, whilst retaining fundamental eye movement parameters like fixation position, duration, and saccadic amplitude. It also controls for scanpath shape, which can differ depending on the task at hand (e.g. Johansson, Holsanova, and Holmqvist, 2011).

Three experiments evaluated scanpath similarity with respect to task difficulty in different ways. In each experiment participants were presented with the numbers 1-5 and their task was to saccade to each number in order. In Experiment 1 the numbers were of different size per trial, according to five levels of task difficulty (small to large). In Experiment 2 the numbers were presented along with a varying number of distractors, giving five set sizes (1-6: 1-10), easy to difficult. Experiment 3 introduced noise by degrading the background in five steps relative to the numbers themselves, making them harder to identify in peripheral vision. Task difficulty was manipulated under these conditions according to the hypothesis that when the numbers are less conspicuous, participants will produce more divergent scanpaths between individuals. This was assessed both with our multidimensional scanpath similarity metric, and with the most advanced alternative: ScanMatch (Cristino, Mathot, Theeuwes, and Gilchrist, 2010).

Results revealed that scanpaths do indeed become less similar as the task becomes harder, but critically this depends on the task. Smaller numbers are harder to locate, but the larger margin of spatial error for fixating bigger numbers leads to scanpath variability. Conversely, larger set sizes are more difficult, with decreasing similarity in terms of position and shape as task difficulty increases. However, the oculomotor system compensates with a greater number of shorter fixations, actually improving performance accuracy. Only when the task was made harder with increasing background noise, were both the ocolomotor and scanpath comparison measures consistent, both for our multidimensional method and for ScanMatch.

These results indicate the importance of task and stimulus features when considering scanpath similarity, as well as the subtle interplay between basic eye movement events and the kinds of similarity they produce.

Language learning and gaze in text-based interaction

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The main aim of the current project is to develop methods for analyzing language learners' verbalized and non-verbalized noticing (Markee 2000, Schmidt 1990) of grammar and vocabulary, through a combination of interactional and psycholinguistic approaches. At a more detailed level, the project aims to investigate the relationship between teachers' corrective feedback strategies and learners' signs of noticing. In the project, learners of English interact with future or practicing teachers of English in Synchronous Computer-Mediated-Communication (SCMC). The particular affordances of SCMC allow for a combination of an interactional analysis of the emerging conversation and an analysis of the individuals' focus of attention in relation to linguistic content and form, primarily through the employment of eye tracking and keystroke logging equipment (cf. Smith 2010). After the interactive task, data for triangulation is collected. It is suggested that the proposed novel setup can be used to evaluate the effects of different types of interactive teaching strategies on learners' language awareness. Schmidt (1990) introduces the concept of noticing, and argues that "[i]n order to overcome errors, learners must make conscious comparisons between their own output and target language input." (Schmidt 2010:4) Research on classroom interaction has seen verbalized repair from the learner as a sign of noticing (cf. Markee 2000). However, it has also been suggested that it would be unnatural to always verbalize noticing through repair (Aston 1986). From this follows that not every aspect of noticing will be verbalized in interaction, and that learning might take place without being made explicit. The current project will result in suggestions for how interactional and psycholinguistic perspectives on noticing and language learning can be combined, something which is difficult to accomplish by focusing on regular classroom interaction.

This presentation will focus on study design and potentially relevant gaze patterns. It is argued that noticing in text-based language learning, and especially re-identifying previous errors after corrective feedback, involves similar processes as those investigated in global text processing (cf. e.g. Hyönä et al. 2003) and in the inconsistency paradigm (cf. e.g. Rinck et al. 2003), and the specific measures in focus here are scan path sequences and lookback/second-pass fixation times. The presentation will also include a discussion concerning the sometimes complex methodological considerations that are part of combining interactional and psycholinguistic perspectives, as well as qualitative and quantitative analyses.

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How a picture can foster comprehension of text: Evidence for scaffolding

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In studies on learning with text and pictures, learners are often required to construct mental models of causal systems, where extracting the system's spatial structure precedes understanding its functions (Hegarty & Just, 1993). To construct a mental model of the spatial structure of a causal system from text, text has to be interpreted, leaving room for erroneous inferences about the system's spatial structure (Schnotz & Bannert, 2003). In contrast, a causal system picture is analogous to the required structure of a mental model of the causal system, and thus adding a picture to text can facilitate mental model construction (Hegarty & Just, 1993). Further, perception of pictures proceeds from global to local (Navon, 1979), meaning that information on a global level (i.e., gist) is extracted from a first glance at the picture, but information on a local level (i.e., visual details) is not. Since the gist of a picture is assumed to represent the picture's global spatial information (Oliva & Torralba, 2006), we assume that the global spatial information extracted from briefly inspecting a causal system picture may act as a mental scaffold, facilitating mental model construction of the causal system's spatial structure from text, and in turn comprehension (i.e., scaffolding assumption).

The scaffolding assumption was tested in two experiments using a pulley system as to-be-learnt content. In Experiment 1, 85 participants had to draw a pulley system either without seeing a picture of it, after inspection of the pulley-system picture for 600ms or 2sec, or after self-paced picture inspection time. Results revealed that spatial information on a global level (i.e., diagonal pulley orientation), but not on a local level (i.e., pictorial relations) were extracted from inspecting the pulley system picture for 600ms and 2sec. In Experiment 2, 84 participants learned about the structure and function of pulley systems from text or from text with previous presentation of a picture (same as in Experiment 1) for 600ms, 2sec, or self-paced. The text did not contain information about the diagonal orientation of pulleys in the system (i.e., global spatial information); this information could be extracted only from (brief) initial picture inspection. Text was presented auditory while participants looked at a blank screen (cf. blank screen paradigm; Altmann, 2004). Participants' eye movements on blank screen while listening to text and comprehension of the pulley system's functioning were assessed. Participants' eye movements were analyzed by means of the standardized relative frequency of saccades made according to the global spatial information (i.e., about diagonal pulley orientation) that could be extracted only from the picture.

Results revealed that in conditions with initial picture inspection (for 600ms, 2sec, and self-paced) more eye movements in line with the picture's global spatial orientation were made and comprehension was better than in the text-only condition. Results from both experiments thus suggest that mental model construction from text was (positively) influenced by global spatial information extracted from brief initial picture inspection, thus supporting the scaffolding assumption.

Studying viewing and learning behavior in video with an eye tracker

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Video is increasingly used as an instructional modality in education. Therefore it becomes more important to improve the learning process of students from video lessons. However, students are traditionally instructed to enhance their learning skills from text rather than from video. Sometimes, the only way to interact with the video is through the control buttons of a media player. This gives students only a few standard options to interact (start and stop) with the video, hardly supporting the learning process of students.

In our experiment, we used an eye tracker to test a new model that addresses both the stylistic and strategic components of students' viewing behaviors. The model is based on metacognition and recent notions on the use of learning styles in education. We applied this model on a group of 115 students to see whether the learning effects differ among students with different viewing behaviors. The students watched several instructional videos in a controlled environment (usability lab with an eye tracker). Every other student (in the intervention condition) was made aware of other possible viewing behaviors in order to enhance learning effects. A pre- post-retention test was carried out in order to calculate learning effects. We investigated whether students with strategic components in their viewing behavior attain higher learning effects. Results show that an awareness instruction helps students with a medium level of prior knowledge in attaining higher learning effects. Students with a low level of prior knowledge do not seem to benefit. In fact, their retention scores are worse. Learning from video and showing other viewing behavior at the same time seems difficult for them.

In the oral presentation, some examples - recorded with an eye tracker - will be shown of viewing behaviors. A large proportion of the experimental subjects exhibited the strategic viewing behavior. So after watching the video in one pass, they watched specific parts of the video again. Some of them used the mouse as marking point on the progress bar to help them remembering the segments to watch again. The eye tracker also revealed metacognitive aspects of learning behavior. Our planned future research targets the specification and implementation of additional operator buttons in order to diversify one's study sequence using the media player. In this way we can implement our findings to help students with strategic viewing more effectively.

How do university students solve problems in vector calculus? Evidence from eye tracking

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Today, learning outcomes in schools and universities are mainly measured with written exams, where calculations and answers to a number of problems are evaluated and graded. You can at best get a glance of how the students have identified the problem, how the problems have been represented and the methods of solutions. However, too often it is impossible from the written information to obtain any detailed knowledge about the processes the students went through leading up to their answers.

Several researchers have used eye tracking to trace the problem solving process in mathematics and related disciplines on a level corresponding to high school education. However, it seems to be a lack of studies in higher education, in particular within the mathematical domain. In this study, we investigate how students divide their attention across text, equations, and graphical illustrations of problems in vector calculus. Since vector calculus is a subject where there is a major need for figures explaining the physical interpretation of mathematical formulas, we are in particular interested in the dynamics between obtaining information from text, mathematical formulas, and figures.

We collected eye movements and speech from 36 second year students from the engineering physics program two weeks into a vector calculus course. The students solved eight problem related to vector calculus presented with text and equations (N = 16) or text, equations, and a graphical illustration of the problem (N = 20). They were asked to 'think aloud' and verbalize their thoughts while solving the problems. The experiment was self-paced, with the restriction that each problem had a maximum allowed presentation time of two minutes. After each question, the students were asked to answer a true or false statement about the problem, and to state how confident they were about their answer.

Overall, we found no evidence that illustrations increased the number of correct answers. However, there were large inter-problem differences; the illustrations significantly increased the number of correct answers in two of the problems and decreased the number of correct answers in one problem. The illustrations also did not seem to change the relative amount of total dwell time on the text and equations compared to the non-illustrated problems. Instead, the time when the illustrations were inspected was taken equally much from other parts of the problem.

These results suggest that care should be taken when designing an illustration to a problem in vector calculus, which, instead of helping the students, may have a detrimental effect on learning.

High quality bicycle tracks result in more efficient visual search patterns during cycling

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Introduction - For a bicyclist to participate safely in busy traffic the ability to foresee events and hazards is vital (Hosking et al. 2010). Therefore, it is important that the bicycle environment allows a shift of attention from the 'personal space' towards traffic events and other traffic users. One factor that might demand a significant proportion of the attention capacity is the quality of the cycling tracks. The presence of irregularities in the surface might prevent the visual attention to shift towards the wide environment (Pelz, 2007), resulting in bad or late decisions that might affect the safety of bicycle users. The aim of this experiment is to investigate to what extent the cycle track surface quality affects visual attention as measured by eye tracking in adult bicycle users.

Methods - Six adults, used to cycling, cycled a tour of 4km in Ghent wearing the iView X HED eye tracker (SensoMotoric Instruments, Berlin, Germany) which recorded eye movements at 50 Hz and a scene video, operating at 25Hz. The route included two bicycle tracks with approximately the same width and similar environment but with different surfaces. One bicycle track was recently renovated and had a brick surface; the other had a surface of large tiles that showed several deformities and cracks. We referred to these tracks respectively as the 'high quality' and 'low quality' cycle track. Both tracks were physically separated from the carriageway by trees and/or parked cars. Since direct sunlight disturbed the infra red signal of the eye tracking system, all tests were performed in overcast but dry weather.

A 30s trial was selected for eye tracking analysis on both the high and low quality track. Gaze cursor overlay videos were analyzed and gaze location was labeled frame by frame as one of the following 5 areas: road, Focus of Expansion (FoE), side (boundaries of cycling track), external and 'other cyclists on track'. When no gaze cursor was visible (no data or gaze outside of camera view) frames were labeled as 'no data'. Fixation duration of 'other cyclists on track' was filtered out and gaze location percentages were calculated per area of interest. Gaze percentages were analyzed using repeated measures MANOVA in which 'quality of the cycling track' was the within-subjects factor and the fixation locations were the dependent variables.

Results and conclusion - Gaze of cyclists was significantly more directed to the road region on the low quality than on high quality cycling track (av. Resp. 66,5% and 24,3%; F=19,942 p=0,007). Cyclists spend less time watching the side of the road and external stimuli on the low quality than on the high quality cycling track (Resp. av. 21.3% vs. 8.3%; F=8.507 p=0.033 and 22.2% vs. 6.7%; F=12.791 p=0.16). Low quality bicycle tracks lead to a less anticipatory visual strategy. Due to the low cycle track quality the cycling task itself became more demanding, which resulted in a shift of attention from distant environmental regions to more proximate road properties. It can be concluded that a low quality cycle track may affect the alertness and responsiveness of the cyclist to environmental hazards.

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The effect of display glare on eye movements when reading

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Glare is a very common source of image degradation on computer displays. Reading is one of the most common tasks performed with computers. Reading is also a task that is very sensitive to image degradation. The aim of this study was to assess the effect of different glare conditions on eye movements when reading.

In a balanced repeated-measurement experiment, 16 subjects (age: 20-35) read texts under four controlled lighting conditions: Overhead light (no glare), Desk luminary (peripheral glare), Window behind (indirect glare), Window in front (direct glare). The subjects read three texts under each condition: First a short standardized text from the Swedish version of the International Reading Speed Texts (IReST)(Trauzettel-Klosinski et al., 2012), secondly a longer newspaper text, and finally an additional IReST text to compare against the first. The texts were read on a Tobii T120 eye tracker.

The results show that glare does have a negative effect on reading performance. The more adverse the lighting condition was, the slower the reading speed became. The decrease was primarily a result of increased fixation durations. Both window conditions (i.e. direct and indirect glare) increased the fixation durations significantly ($p < .05$). This study shows that even moderate glare conditions can have an impact on reading. Even the worst condition in the experiment fell well within recommended luminance levels for workplace environments (SIS, 2011).

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Poster presentations

Evaluation of user preferences during reading of 2D and 3D cartographic visualizations

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The aim of the contribution is to present results of eye-tracking experiments on evaluation of user preferences during reading 2D and 3D cartographic visualizations. Currently, thanks to advances in computer and Internet technology, the production of digital cartographic products is massive. Map makers, cartographers or graphic designers perceive maps differently than the target audience. The considerable degree of subjectivity is put into during the map making. In many cases, the specialist cannot imagine how the map will be used. For these reasons, it is necessary to make research of user perception and cognition of maps.

In modern cartography, it is very popular to depict the spatial information using 3D visualization techniques, perspective views and pseudo - 3D techniques like hillshade, hill or hatch hypsometry methods. The research question is to find out the real value of 3D cartographic methods for the perception and use of maps. 3D maps are generally considered as a way how to better show the vertical spatial relations, while classical 2D representations (orthogonal maps) are regarded as more suitable for distance and area perception. Both mentioned visualization methods has pros and cons, and it is necessary to objectively specify, which one is suitable for solving different spatial tasks.

To evaluate the utilization of 3D and 2D visualization methods, two eye-tracking experiments were performed using the SMI RED 250 eye-tracker with 120 Hz sample rate. For experiment design, the manufacturer software Experiment Center was used. The data analyses were executed in BeGaze, OGAMA and R software. The first experiment was designed as a set of stimuli containing single maps. Half of them was using 3D visualization, whereas the second half was in 2D. Purpose of this experiment was to evaluate users behaviour during answering the spatial query (e.g. Find the highest peak, Find the furthest point, etc.). The second experiment was focused on finding out the user preferences between both visualization methods. Stimuli was represented as a pair of maps in 2D and 3D side by side.

Results of the experiments are based on statistical analyses of various eye-tracking metrics (fixation duration, fixation/saccades ratio, AOI dwell time, time on task). The overall goal of the research is to create a theoretical framework for investigating effectiveness and preferences of 3D and 2D cartographic visualizations. Eye-tracking technology was not fully utilized in the cartography or geosciences yet. It is clear that it will have great importance in optimization of cartographic products and visualization of geographic data in the future.

Visualisation of elevation information on maps: An eye movement study

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Traditionally, information about elevation variation on a topographic map has been represented with contour lines. Compared to plain contour lines, depicting landform and elevation through slope shading or oblique view representation may provide more intuitive and realistic representation of the environment. However, more realistic, detailed representations may not be appropriate for map tasks (Hegarty et al., Cartographica, 44, 2009, pp. 171-186.). The aim of the study was to evaluate the effect of elevation visualisation on eye movements and performance in four different map-related tasks.

The stimuli maps depicted the same real geographical locations in three visualisations. Twenty-six participants were divided into three groups according to these visualisation types. The visualisation types were (only) Contour lines, Slope shading (in addition to contour lines), and Oblique view (triangle grid instead of contour lines).

The experiment consisted of four map tasks.

1. The search task: Search for a pentagon-shaped symbol on the map
2. The height comparison task: Judge which one of the two points is at higher elevation
3. The area selection task: Select a hiking area from the map.
4. The route planning task: Plan a realistic route from a starting point to a destination.

The response time were recorded in all the tasks. In the search task and height comparison tasks the accuracy of performance was measured and in the selection and planning tasks the participants explained their choices verbally. From the verbal data, the words related to elevation were extracted, and the number of trials containing these words were compared between the groups. The eye movements of the participants were recorded during all the tasks. From the eye movement data, the number of fixations and fixation durations as well as saccade durations and amplitudes were analysed.

The response times differed between visualisation types only in the height comparison task: Oblique view was fastest and Contour lines slowest. However, the Oblique view produced more incorrect answers than the two other visualisations. The results showed no differences in the number of trials containing words related to landform or elevation. Compared to other visualisation types, the Slope shading produced shortest average fixation durations in all the four tasks. On the other hand, in the height comparison task, all the eye movement measures differed between the visualisations: Contour lines required more fixations and induced shortest saccade amplitudes.

The visualisation of elevation information affects eye movements, particularly the average fixation durations. The shortest average fixation durations in the slope shading visualisation may indicate that it was regarded less complex than the other visualisations (Hooge et al. in Eye movements: A window on mind and brain. 2007), or that the contrast and spatial frequencies differed between the visualisations. However, due to the research design the individual variation in eye movements may have affected the results. The results also showed that the experimental task affects eye movements as has been showed in previous research (Rayner, Quarterly Journal of Experimental Psychology, 62, 2009, pp. 1457-1506).

Neural correlates of oculomotor, low-level and high-level processes during free viewing of natural scenes

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Neural activity during visual attention task is a combination of high and low level visual processing. Low level processing consists of oculomotor activity and processing of physical image properties such as contrast, luminosity and frequency. High level processing on the other hand is guided by memory, image content and intention. This experiment investigates the effects of local changes in physical image properties on neural activity in a scene perception task. The overall aim of this study is to gain more insight into what guides visual attention, that is, how the oculomotor, low level physical image properties and high level factors related to image semantics interact in scene perception. In addition, we hope to improve the co-registration of eye movements with EEG/MEG that allow for more ecologically valid experimental setups.

The experiment is a free-viewing scene perception task where subjects will be presented with three kinds of visual stimuli: natural scenes, scrambled scenes and blank scenes. The natural scenes consist of photographs. The scrambled stimuli consist of same images as the first ones but meaningful content is randomly scrambled inside a 4x4 grid. Scrambled scenes still retain the same local image properties as the natural scenes. In addition to the two stimuli a control condition of a blank screen with same dimensions and grid is used. In each trial, the subject is presented with two images. First image is a small patch equal to the size of one grid element in the 4x4 grid. The second image is a full scene image and the subject is asked if the patch can be found in this image.

Preliminary study of the validity of the experimental setup was conducted at the Lund Humanities Laboratory with 10 subjects. In the pilot experiment, subjects' eye movements were recorded using a high-speed eye-tracker. The experimental setup was as described above, but the blank condition was omitted. The results showed that median fixation duration and the median dwell time on the areas-of-interest (AOIs) visited were longer for the natural scenes as compared to the scrambled scenes. Conversely the number of AOIs visited was larger in the scrambled scenes. These results coincided with the results reported by Foulsham et al. (Atten. Percept. Psychophys, 7, 2011, pp.2008-2025).

Currently the final experiment with EEG/MEG and eye tracking is underway. In this experiment the neural activity is recorded with EEG/MEG concurrently with eye movements. Simultaneous co-registration of eye movements allows us to bypass common obstacles related to free-viewing paradigms with EEG/MEG. The information about where the subject is looking at during the experiment (provided by the eye-tracker) enables us to synchronize neural activity related to local properties of the stimulus images.

Relation between motion perception and gaze direction. Evidence from VOG eye tracker

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Objectives

The relation between motion perception and eye movements is still controversial (Spering and Montagnini, 2011). Some findings concerning pursuit eye movements suggest that both common and distinct mechanisms guide perceptual and motor responses to visual motion information. However, these studies measure mainly eye movements velocity as compared to stimuli velocity. It is still unclear if different motion stimuli would elicit specific spatial patterns of gaze. This study aims to analyze how coherent motion perception is related to gaze direction by measuring eye movements' spatial information.

Methods

The eye movements of eight healthy participants (mean age 19.9 years) have been recorded during a motion coherence discrimination test. The stimuli consists of 100 white dots (0.2°) moving at constant velocity on a black background. The area subtending the motion is a circular frame (7° of diameter). Each dot has a limited lifetime of 200 msec. The coherence level is held constant at 4 decibel (i.e. 36% of dots move coherently in one of eight possible direction, cardinal or oblique, while the rest moves in Brownian manner). Each subject performs eight tasks, one in each direction of motion. In order to measure the gaze pattern of exploration during the motion perception, the stimuli duration is set at 3 seconds. The subject is asked to discriminate the direction of coherent moving dots and his gaze position is recorded binocularly. For this purpose an eye tracker SMI 500 is employed. It is a non-invasive, image based system using a remote-controlled infrared eye camera with automatic eye and head tracker. The system maximum sampling frequency is 500Hz. In our experiment the 120Hz resolution is used. Horizontal and vertical components of gaze are represented in XY graph. Confidence ellipses of gaze are calculated as the area subtending the 95% of horizontal by vertical gaze position. The principal axe inclination is considered as indicative of the main gaze direction and it is compared to the direction of motion stimuli.

Outcome

The gaze direction does not always correspond to stimuli motion direction even in those subjects who perceive correctly the motion. However, the evaluated confidence ellipses show that the principal axe is longer than the other axe suggesting that the stimulus is explored by specific directional eye movements and not by random gaze position. From these results it could be hypothesized that the space exploration of moving stimuli is specific to motion detection, confirming the important contribution of eye movement analysis in perception strategies investigation.

Gaze evaluation of the St. Erik Eye Hospital web page

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* Interaction Design Technology ** St. Erik Eye Hospital

In 2010 St. Erik Eye Hospital worked out a more accessible and recipient adapted website. To evaluate navigation, search feature and the information on the contact pages we performed a user test in form of an eye-tracking study. The aim was to ensure that the audience found relevant information. 10 people got to test the new site by using eye-tracking equipment. The result showed that there were potential in the classification of substances and menus, the search function to display and menus location and appearance. Using the test results we were able to adjust the data structure, improve navigation and develop our internal search engine.

Text comprehension during noise exposure: Effects on eye movements, galvanic skin responses and subjective performance

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In everyday urban life, noise and music is constantly present all around us, and there are few places where reading can be done in complete silence apart from studying in your own home, if even there. It is therefore necessary to further investigate how sounds tax cognition and facilitate or impede reading. Studies in acoustics and environmental medicine have shown evidence of cognitive effects of noise exposure. Furthermore, a previous study within this project showed that reading comprehension was negatively affected by music that the participant stated they would never use as study music, but not by music they preferred, café noise and silence. Crucially, the gaze behavior apart from pupil size was unaffected. The present study aims to investigate how reading behavior is influenced by noise presented at different sound pressure levels. In order to examine this, we collected eye movement data and galvanic skin response (GSR) for participants presented with multitalker babble noise presented at different levels during a reading comprehension task. Eye movement data were recorded binocularly with a tower-mounted SMI Hi-Speed eye tracker at 500Hz, and GSR with a BIOPAC system at 500Hz. The participants were presented with a babble noise at 50dB SPL and 70dB SPL, as well as a silent control condition, while reading texts with corresponding reading comprehension questions. The research questions are: do noise presentation level influence gaze behavior and other physiological responses during a text reading task; do stress levels (GSR) change with sound pressure levels (SPL), and how do stress levels affect eye movements and text comprehension; and does different sound pressure levels affect physiological process measures and cognitive product measures differently?

The 70 dB SPL noise condition was subjectively reported having a more negative effect on task performance than the 50 dB SPL noise condition, which in turn was reported having a more negative effect than the silent condition. However, the results showed no negative effect, and fixation duration, saccade amplitude, regressions, and second pass reading were largely unaffected. However, there was a significant effect on pupil size and blink rate. Furthermore, the GSR data indicated increased stress during the 70 dB SPL noise condition compared to the other ones, and the data suggested an interaction between noise level and test duration.

Findings suggest that noise does not affect text comprehension or higher level gaze behavior such as fixation duration, saccade amplitude and regressions. Crucially, low level cognitive systems such as stress levels (GSR), arousal (pupil size) and blink frequency were all influenced by sound pressure level. Therefore, future studies will examine the effect of different background noises on eye movements and GSR on a lower level than reading comprehension. Reading makes it difficult to isolate exactly what measures that are affected by the sound environment, and almost no results on reading behavior were found in the two previous experiments. Furthermore, participants reported the noise as being disturbing, and stated that they felt it worsened their performance, something that the product measures disprove. However, the GSR data suggest an effect of test duration. Future research should thus examine if even longer test durations affect performance.

Translog-II: A program for recording user activity data for empirical reading and writing research

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This paper presents a novel implementation of Translog-II. Translog-II is a Windows-oriented program to record and study reading and writing processes on a computer. In our research, it is an instrument to acquire objective, digital data of human translation processes. Translog-II consists of two main components: Translog-II Supervisor and Translog-II User, which are used to create a project file, to run a text production experiments (a user reads, writes or translates a text) and to replay the session. Translog produces a log files which contains all user activity data of the reading, writing, or translation session, and which can be evaluated by external tools.

Translog-II has three main functions:

1. create a project file:
   - determine the size and orientation of a source and a target window on the screen for reading and writing permission respectively.
   - produce texts for the source and/or the target window, their layout, text font, size, color, line spacing etc.
   - determine which data are to be logged, keyboard and eye-tracking

2. run and record a Translog-II session:
   - load a project file
   - calibrate eye-tracker (if connected)
   - record and log UAD

3. replay and analyze a recorded log file:
   - statistics: figures about text production/ elimination/ navigation events
   - user view: replays the translation session in time
   - linear view: plots a textual representation of the UAD
   - pause plot: shows a 2D representation how the text emerge in time

The Translog-II Supervisor program implements the functions 1. (create a project file) and 3. (replay a log file), Translog-II User is only used to record a Translog session and to store the UAD in a log file. A Translog-II project file can be configured for a reading experiment, where only the “source window” will be visible during the recording session, it can be configured for a writing experiment, where only the “target window” is visible in which a text can be typed, or for a translation experiment, in which both windows are visible. In fact Translog-II also allows for post-editing texts, if a pre-defined text is entered in the target window. Translog-II allows the source and the target windows to be horizontally or vertically oriented and the source or target windows to be left or right, or bottom or top.

Similar programs such as ScriptLog (http://www.scriptlog.net/demo.asp), and InpuLog (http://www.inputlog.net/download.html) are mainly intended for logging and analyzing writing processes, while Translog is specially designed for the acquisition of data for translation process research, and is widely used in the translation process research community. Schou et al (2009) count more than 80 publications making use of Translog, for translation process research of linguistic phenomena, (e.g. the translation of metaphors, cognates, idioms, etc.) as well as translator behaviour and cognitive processes (e.g. translator's awareness, memory constraints, (self)revision etc.), translation expertise, translation under time pressure, and machine translation post-editing. Translog is also used for translator training, teaching and learning purposes.

Othello against Duchenne – where do we look and how good are we in detecting fake versus real smile

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"In a sense, the face is equipped to lie the most and leak the most, and thus can be a very confusing source of information during deception"
Ekman and Friesen, 1969, p.98

“And how can you possibly know that I have told lie?”
“Lies, my dear boy, are found out immediately, because they are of two sorts.
There are lies that have short legs, and lies that have long noses.
Your lie, as it happens, is one of those that have a long nose.”
Collodi, “Pinocchio”, 2007, p.74

The smile is universally recognized from facial expressions or so it has been claimed. It has been observed in many studies that happy or smiling faces are recognized more quickly and with higher accuracy that other facial expressions (Ekman & Friesen, 1982). Nevertheless, judgments of observers whether the person is lying or not are not better than chance (e.g. Ekman & Friesen, 1974; Ekman, 1988). Poster presents two studies on real versus fake smile detection. First study focuses on the effect of time exposure (200 ms, 5000 ms), nationality (Poles, Swedes) and gender (male, female) on detecting fake smile from photographs. Time, nationality and gender turned out to be significant. The longer time the higher participants judge sincerity, authenticity and trust of presented people. The aim of second study, beside studying the accuracy of recognition Duchenne and fake smile, was to find out where participants search for clues about authenticity of smile. Two series of pictures presenting real and fake smile were presented to subjects in two exposure time 500 ms and 5000 ms. Subjects were asked to assess sincerity of presented person, authenticity of smile, trust and liking for them. In addition, eye tracker was used to record data on eye movement and fixation on the interesting areas of the face: eyes and mouth.

The results showed that subjects made significantly more fixations on eye area compared to mouth area in both time exposure conditions. Smiles from pictures, both real and fake, were significantly higher assessed in case of short exposure compared to longer one. No statistically significant differences were obtained between the assessment of real and fake smiles - subjects were not able to distinguish real from fake smiles. Results given above stand for "Othello Error" (Ekman, 1992) which is when a truthful person (in this case people presenting Duchenne smile) is perceived as to be lying. Low accuracy in real versus fake smile detection might be inconsistent with significantly longer time spent on fixation on the eye area, because it might means that subjects are able to see engagement of orbicularis oculi muscle (which orbits the eye, moves cheeks up, bags skin below eye and make crow’s feet wrinkles) and they are unable to perceive it as a clue for realness of smile. All results will be discussed in poster presentation.

Keywords: detection, facial expression, fake smile, smile, Othello error

Viewing emotional images: evidence from simultaneous EEG- and eye movement recording

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Emotional stimuli draw attention and give rise to electroencephalography (EEG) markers specifically related to affective processing. The aim of this study was to examine the eye movement behavior and oscillatory responses in the EEG when the subjects were viewing emotional and neutral images. Co-registration of eye movements and EEG data was used in order to present the emotional stimuli in a more naturalistic and complex setting.

Studies on brain oscillatory activity have identified several frequency bands in which activity varies as a response to emotional stimulus content. Oscillatory activity in the theta band has been shown to vary in response to images, faces and music with emotional content in several studies, and was therefore chosen as the EEG component of interest in this study. Eye movements were analyzed in order to see whether emotional images attract attention faster and for a longer duration than neutral images, and whether the first fixation in a trial usually lands on an emotional image, proving that emotional content does indeed attract attention parafoveally. The eye movement variables used in the study were target entry time, number of fixations and dwell time (i.e., the sum of fixation durations on the target region).

The EEG and eye movements of 19 subjects were recorded while they were freely viewing the stimulus images. The images were presented so that subjects saw four images at once in each corner of the computer screen. One of the images was a target image, which was either negative, positive or neutral in emotional content. The other three images were neutral. The low-level visual features of the images were controlled for. Information about where the subject's gaze was directed at each time point was used to time-lock the EEG analysis to those time points when the subject was looking at a target image.

The EEG analysis demonstrated that activity in the theta frequency-band synchronized more in response to emotional than neutral images across the scalp. The observed effect occurred during ~100-600 ms after the first transitional saccade to the target image, and was more prominent for negative than positive images. This result confirms the role of theta oscillations in emotional processing also in a more naturalistic setting (i.e., during free viewing). The analysis of eye movement revealed that emotional images received more fixations and they were looked at for longer than neutral images. Emotional (especially negative) images were fixated on faster than neutral images, which confirms prior findings suggesting that subjects are able to identify the emotional content of an image parafoveally. The results from this study also validate the use co-registration of eye movements and EEG during a free viewing paradigm to study visually induced brain responses.

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Eye tracking interface design for controlling a mobile robot

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This poster presents a baseline study for an eye tracking user interface design for controlling a mobile robot. The baseline study is an experiment involving the use of a radio controller (RC) to drive the robot, while gaze data is collected from each subject monitoring the position of robot on the remote screen that displays the view for the turret-mounted video camera on the robot. Initial data from the experiment provides a foundation for interface design of actual control of the mobile robot by gaze interaction.

Such an interface may provide Tele-presence for the disabled. Patients with motor disability cannot use their hands and legs but only use their eye motions. Such applications of an eye tracking system can provide patients with much flexibility and freedom for search and identification of objects. The research holds significant importance for providing the users with motor neuron Disability for Tele-presence by utilizing state of the art technology integration. The study will produce a simple, accurate, efficient, and effective interface design for users. This study provides a foundation for building the interface in the next phase.

The evolution of Information Technology and Computer Science provides a potential for integration of eye tracking and mobile robot technologies. This creates possibilities and multiple interrelated applications may be developed.

SMI Eye-tracking device for control map application by sight

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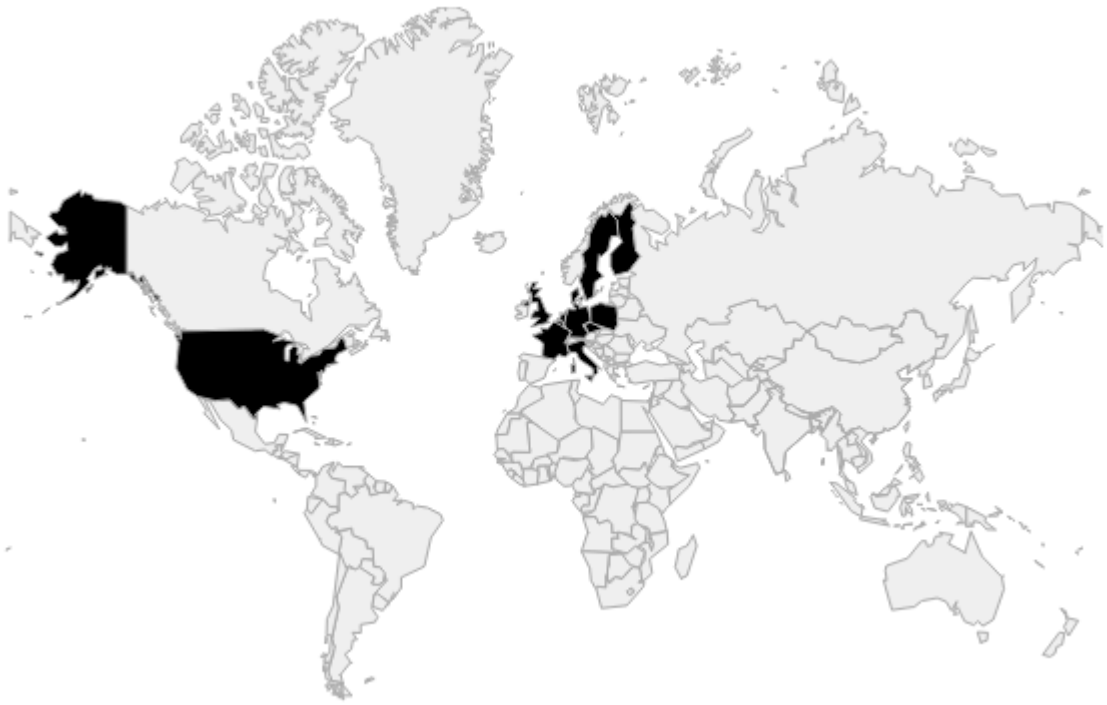
Tracking person´s eye movements have been used in many fields since the last decade. The eye tracking system is a device for measuring eye positions and eye movement ("where we are looking"). There are many approaches for research on user perception and evaluation of the usability and effectiveness of cartographic and geoinformatics products as well. Eye-tracking system offers great opportunity for objective analysis and evaluation, but there are not many ideas of non-contact control of map application by sight. The mouse and keyboard are inherent parts of computer for locomotive control nowadays and there is the same potential for control by sight for the future. But on the other side it requires the physical processes. Control by sight eliminates all constrains associated with locomotive control. It can be used by disabled users, in specialized field like army or aviation, as well as wide range of home users.

This poster presents eye-tracking research made on first eye-tracking device in the Czech Republic used on the field of cartography and geoinformatics. It generally describes eye-tracking technology for non-contact control, and then is followed by approach of map application control by sight. It is developed on SensoMotorics Instrument (SMI) device and SMI Experiment Suite 360° software. There have been elected rectangle areas located near the edge of map, with some time delay function. When user localizes one of these areas the map automatically moves to the way on which edge is localized on, short time delay prevents an accidental movement. The technology for recording the eye movements on the screen offers this option because if you properly define the layout and function controls, you need only connect these two components. The solution of movement control is based on data transmission between eye-tracking-device-output and converter in real-time.

Participants



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