IVL meeting Abstracts

University of Akureyri

5.-6. october, 2018

1 Session 1: Friday, 14:00 - 15:30

1.1 The role of visual attention and feature-based processing in reading problems:

Heiða María Sigurðardóttir

We measured visual attentional and visual perception abilities of adults (N = 60) with varying degrees of reading abilities. They performed feature and conjunction visual search, as well as global form and feature-based face matching. Slow searchers, especially in conjunction search, were more likely to have reading problems. However, associations were no longer significant when symptoms of ADHD, comorbid with reading problems, were factored out. The results provide weak support for the dorsal view of dyslexia according to which reading problems stem from a visual attentional disorder. Poor readers were on average worse than typical readers on feature-based face processing but were not disadvantaged on global form face processing. This association was weak, but became stronger when non-specific factors were partialled out, consistent with specific problems with feature-based processing. Results provide moderate support for the ventral view of dyslexia where problems with visual object perception mechanisms are thought to cause reading deficits. Finally, we came across laterality effects where performance was better in feature-based face matching when faces were right-facing compared to left-facing, while the opposite was true for global form face matching. We speculate that this is due to differential recruitment of left and right hemisphere face processing mechanisms.

1.2 The role of featural processing in reading deficiency

Bahareh Jozranjbar

Developmental dyslexia is a common learning disorders affecting up to 17.5 percent of the population. Dyslexia is typically described as a phonological deficit, but the role of phonological factors depends on the orthographic depth of different languages. Some dyslexic readers can perform phonological tests properly but might have difficulty in reading fluently. This leads to the hypothesis that other factors might play an important role in dyslexia. A central question of my doctoral thesis will be whether reading difficulties of dyslexic readers stem from a more general high level visual deficit. There is evidence indicating that high level ventral stream regions - in or close to the left fusiform gyrus that supports word, face and other visual object processing - are hypoactive in dyslexia. These regions are more involved in featural processing while the corresponding right hemisphere regions are more involved in configural or holistic processing. This is consistent with previous research that has demonstrated that holistic processing of faces in dyslexic readers is intact. We will investigate whether dyslexic readers are at a particular disadvantage when it comes to featural processing, and whether this is specific to certain object classes. To answer this question, we will manipulate configural vs. featural based information of faces and houses. The results of the current study may be theoretically important for identifying factors that lead to dyslexia and could eventually guide the development of novel methodologies for identifying people who are at the risk of dyslexia and hopefully improve the training programs for dyslexic readers.

1.3 (In)Stability of linear signal interdependencies in the EEG

Yvonne Höller

Background: It seems that the reproducibility crisis has merged forces with the elusive concept of brain connectivity to ease the publication of neuroscientific results that are easily misunderstood and impossible to replicate. The presented studies provide an introduction to the problems with low test-retest reliability of connectivity measures derived from multivariate autoregressive models of electroencephalographic (EEG) signals. Methods: A sample of 60 participants (healthy and neurological subgroups) participated in two resting EEG sessions separated by two weeks. Connectivity measures (14) were extracted and correlative approaches were employed to identify moderators of reliability. Additionally, we tested the biometric potential of connectivity measures. Results: Reliability depended on the choice of the measure, artifacts, signal length, model order, frequency range, and pathology, with patients with temporal lobe epilepsy showing highest test-retest reliability. Moreover, biometric analysis revealed that the EEG-type fingerprint of the brain was more reliable in women. Discussion: Modeling brain networks from signal interdependencies needs careful selection of the parametrization of the model and detailed reporting of sample characteristics. I Outlook: Stable metrics are a prerequisite for the progress of neuroscience, but could also propel the EEG forward to become a biometric modality that is universal and not easy to circumvent.

1.4 Repeated retrieval from visual short-term memory

Peter Shepherdson

How does retrieval affect the contents of visual short-term memory? To address this question, I ran a series of experiments in which I asked participants to memorise and then repeatedly recall the colours of shapes presented singly, in pairs, or in groups of three. Responses increasingly deviated from the presented values as participants recalled the colours, yet the stability of the responses also increased. An analysis of changes in response entropy indicated that the greater stability of later responses did not reflect a reliance on stereotyped, categorical colour representations. Allowing participants to make their first response from perception, rather than memory, mildly enhanced the accuracy of subsequent responses. Initial modelling efforts showed that the best models tended to include the creation of novel memory traces when participants respond, analogous to Rickard and Pan's (2017) account of testing effects in long-term memory. However, none of the models effectively captured all the key patterns from the data, with most missing the finding of increasing response stability.

2 Session 2: Friday, 16:00 - 17:00

2.1 The effects of distractors distribution learning and serial dependence on perceived orientation

Mohsen Rafiei

Implicit ensemble learning research shows how humans can learn the statistical distribution of visual features in a scene, representing them as a probability distribution (PD) in feature space. Also, serial dependence research has shown how what we have seen before affects our current perceptions. An unanswered question, however, is whether our perceptual processes can be influenced by recently learned feature probability distributions. To answer this question, we modified a method introduced by Chetverikov, Campana & Kristjansson, 2016 where participants learn the distribution of a set of line orientations. In the current study, after several visual search trials where observers searched for an oddly oriented target among distractors from a certain distribution, they had to perform a single bar orientation adjustment task to investigate whether the learned distribution of distractor orientations influenced the orientation judgments in the matching task.

2.2 Explicit and implicit judgments of distribution characteristics: Do they lead to different results?

Sabrina Hansmann-Roth

Objects have a variety of different features that can be represented as probability distributions. Previous findings show that besides mean and variance, the visual system also encodes distribution shape. Visual search studies showed how previously learned properties of distractor distributions influence search times where the underlying shape of the distribution was assessed through RT changes. Here, we compare this implicit method with explicit judgments of mean, variance and higher order statistics from a 2AFC task. Subjects learned particular properties of distractor distributions over trials and then compared two distractor sets of varying mean and variance. Results from the 2AFC task yielded much noisier representations than our implicit method. Analyzing the learning of particular properties of the distractor distributions between the two methods reveal the costs and benefits of explicit and implicit judgments as tools to assess internal representations of feature distributions.

2.3 Encoding perceptual ensembles during visual search in peripheral vision

Daglar Tanrikulu

Observers can learn complex statistical properties of visual ensembles, such as the shape of their underlying distributions. Even though ensemble encoding is critical for peripheral vision, distribution shape learning in the periphery has not been studied. Here, we investigated this using a visual search task, in which observers looked for an oddly oriented bar among distractors taken from either uniform or Gaussian orientation distributions with similar mean and range. The search array was presented either in the foveal or peripheral visual field. Our results revealed shape learning can occur both in the foveal and peripheral visual field depending on the scale of the search array. Given the importance of crowding and texture perception for peripheral vision, these results suggest an interesting interaction between those and ensemble encoding.

3 Session 3: Saturday, 10:00 - 11:30

3.1 New insights from visual foraging tasks into visual attention and visual working memory

Árni Kristjánsson

The assessment of the functional properties of visual attention and visual working memory has in past decades been dominated by single-target visual searches. But our goals from one moment to the next are unlikely to involve only a single target, and more recently, paradigms involving visual foraging for multiple targets have been used to investigate visual attention and working memory. Set-size effects in single-target visual search tasks partly form the foundation of many theories of visual search. We therefore manipulated set-size in a visual foraging task, involving both “feature” and “conjunction” foraging. The target selection times during foraging revealed specific components of the foraging pattern indicating that single-target search tasks only provide a snapshot of visual attention. Foraging tasks can also provide insights into the operational principles of visual working memory, and our results indicate that participants are able to change their foraging patterns according to task demands suggests that visual working representations used for attentional guidance are flexible, but not restricted to a single value as some current theories suggest. Our results show how single-target visual search tasks vastly undersample the operation of visual attention and visual working memory, providing only a snap-shot of the function of visual attention and visual working memory and this limited information is bound to be reflected in theoretical accounts based on such tasks.

3.2 Visual foraging as a tool for investigating visual attention

Tómas Kristjánsson

Given the enormous amount of stimuli constantly bombarding our senses, our ability to filter out those stimuli relevant to us and the task we are currently engaged in is vital to our survival. This mechanism of filtering out stimuli is more commonly called attention. Visual attention can be studied in many different ways. Such as studying instances when it fails, as in change blindness, the attentional blink, illusory conjunctions and even some illusions. Studying visual attention when it is working, has been dominated by the study of single target search. This has provided the groundwork for most models of visual attention and has proved to be a very fruitful line of investigation. In real life, our attention is often not only deployed to the search of a single item. Be it searching for all the jigsaw puzzles that have corners, searching for the correct coins at the supermarket or picking berries in the wild. When we are searching for multiple objects, we call this foraging. Studies of human foraging have only recently been used to investigate the nature, the limits and the capacity of visual attention. Here I discuss and describe how one such foraging task has been used to gain insight into the workings of visual attention and how this insight adds to our understanding of visual attention above and beyond what the single target search paradigm can offer.

3.3 Visual foraging and executive functions: A developmental perspective.

Inga María Ólafsdóttir

Visual foraging, where participants search for numerous targets among distractors, is a dynamic way to study visual attention. To contribute to the mapping of foraging abilities throughout childhood and to assess whether foraging is dependent upon executive functions (EF), we compared the foraging of 66 children aged 4-7 years (mean age = 5.68 years, SD = 0.97 years, 33 girls), 67 children aged 11-12 years (mean age = 11.80 years, SD = 0.30 years; 36 girls), and 31 adults aged 20-37 (mean age 30.32 years, SD = 4.37 years, 18 females), with a task involving multiple targets of different types. We also measured three subdomains of EF; inhibition, attentional flexibility, and working memory. Foraging ability improves dramatically between ages 4 and 11, evident by different foraging patterns, quicker foraging, and greater ease with switching between target types. Lastly, a connection was established between foraging and self-regulation, working memory and attentional flexibility, but not inhibition. Foraging is a promising way to study visual attention and its development throughout the lifespan.

3.4 Revisiting the lack of top-down control of feature-based attention

Árni Gunnar Ásgeirsson

The idea of feature-based attention is largely reliant on the assumption that humans can voluntarily direct their attention towards certain features of their visual environment. The strong version of this assumption has been challenged by Theeuwes and colleagues in several publications. In short, they claim that the early processes of attention are completely dependent on stimulus salience and selection history (e.g. reward associations and/or repetition priming). Theeuwes and van den Burg (2012) ran several experiments using a version of the additional singleton paradigm (Theeuwes, 1991). In this version, 7 stimuli were present in a circular array: five distractors, a salient distractor and a target. Subjects reported whether a bar enclosed in the target had a horizontal or vertical orientation. The target identity was only known after interpreting a word or color cue, presented before the appearance of a stimulus array, forcing the subjects to use this knowledge to perform the task. The critical factor in the study was the congruence or incongruence of the oriented bars within the target, and salient distractor, respectively. If subjects were able to use feature-based attention to ignore the salient distractor, the orientation of distractor bar should not impact response times. Yet, Theeuwes and van den Burg (2012) found that there was a robust congruence effect in multiple experiments, suggesting that perfect feature-based selection was impossible. Notably, the congruence effect disappeared when target and distractor colors were repeated on consectutive trials, suggesting that color priming could lead to perfect selection. Here, we replicated the experiments of Theeuwes and van den Burg

(2012) in a large sample of students. The replication study confirmed the inability to completely ignore salient distractors. However, the size of the congruence effects was not diminished by repetition priming. Priming and congruence were found to be completely independent factor. The results suggest that feature-based attention is even weaker than claimed by Theeuwes and van den Burg. Under no conditions were subjects able to perfectly select a target, based on foreknowledge of a target feature.

4 Session 4: Saturday, 12:30 - 13:10

4.1 Identifying and evaluating the benefits of lower-limb neuroprostheses

Vigdís Vala Valgeirsdóttir

Although prosthetics have improved greatly through the years, users want even more sophisticated solutions enabling them to traverse uneven terrain, kneel and even dance. There have been recent developments in the field of advanced lower-limb prosthetics, which add the new dimensions of sensory feedback and new control strategies. The clinical benefits as well as the effects of feedback and intent control on the user remain largely unknown and so there is a need for adequate methods to evaluate their usability and effectiveness. Level ground walking is usually the main parameter used to evaluate a prosthesis, which is unsatisfactory to assess user abilities to perform many such tasks required during daily use. The project's goal is to develop testing procedures to evaluate advanced prostheses and identify their possible benefits and effects on the user. The project involves a literature review on prosthetic testing methods, a contextual inquiry involving prosthetic users and specialists examining user needs and potential solutions to them, as well as evaluating test procedures using advanced prototypes. The project is expected to lead to a better understanding of prosthetic user needs, new testing procedures and development of neuroprostheses. Currently, the literature review is being written, the contextual inquiry is being conducted along with preliminary data analysis.

4.2 Measuring Relative Vibrotactile Spatial Acuity: Effects of Tactor Type, Anchor Points and Tactile Anisotropy

Rebekka Hoffman

Vibrotactile displays can compensate for the loss of sensory function of people with permanent or temporary deficiencies in vision, hearing, or balance, and can augment the immersive experience in virtual environments for entertainment, or professional training. This wide range of potential applications highlights the need for research on the basic psychophysics of mechanisms underlying human vibrotactile perception. One key consideration when designing tactile displays is determining the minimal possible spacing between tactile motors (tactors), by empirically assessing the maximal throughput of the skin, or, in other words, vibrotactile spatial acuity. Notably, such estimates may vary by tactor type. We assessed vibrotactile spatial acuity in the lower thoracic region for three different tactor types, each mounted in a 4 x 4 array with center-to-center inter-tactor distances of 25 mm, 20 mm, and 10 mm. Seventeen participants performed a relative 3-alternative forced-choice point localization task with successive tactor activation for both vertical and horizontal stimulus presentation. The results demonstrate that specific tactor characteristics (frequency, acceleration, contact area) significantly affect spatial acuity measurements, highlighting that the results of spatial acuity measurements may only apply to the specific tactors tested. Furthermore, our results reveal an anisotropy in vibrotactile perception, with higher spatial acuity for horizontal than for vertical stimulus presentation. The findings allow better understanding of vibrotactile spatial acuity, and can be used for formulating guidelines for the design of tactile displays, such as regarding inter-tactor spacing, choice of tactor type, and direction of stimulus presentation.