**WIOS 2019, May 24-25 – Wageningen University (NL)**

**Day 1 – Friday May 24**

**Location: Forum (Building 102, Droevendaalsesteeg 2, Wageningen) room C222.**

12.00 – 14.00 Registration

14.00 - 14.15 Welcome (by Sanne Boesveldt)

**14.15 – 15.45 Symposium “Human olfaction”**

Chair: Valentina Parma

14.15-14.20 Introduction

14.20-14.40 Bettina Pause (University of Düsseldorf, DE)

 *Chemosensory contagion of emotions in humans*

14.40-15.00 Camille Ferdenzi (Centre de Recherche en Neurosciences, Lyon, FR)

 *Communication of individual characteristics through human body odor*

15.00-15.20 Jessica Freiherr (University of Erlangen-Nürnberg, DE)

 *Tactile stimuli have the capability to modify odor perception*

15.20-15.40 Ilona Croy (Technical University of Dresden, DE)

 *Nothing is special anymore - the role of olfaction in emotion processing*

15.40-15.45 Discussion

15.45 - 16.15 *Coffee break*

**16.15 – 17.15 Keynote lecture**

Chair: Veronika Schöpf

**Rachel Herz (Brown University and Boston College, USA)**

*A brief review of 30 years of olfactory research*

17.15 – 17.30 See you tomorrow

17.30 Group picture in front of Helix

17.45 – 19.00 Drinks n bites – Helix (building 124, Stippeneng 4, Wageningen)

**Day 2 – Saturday May 25**

**Location: Forum (Building 102, Droevendaalsesteeg 2, Wageningen) room C222.**

**9.00 – 10.30 Symposium “Multisensory food perception”**

Chair: Sanne Boesveldt

9.00-9.05 Introduction

9.05-9.25 John Hayes (Pennsylvania State University, USA)

*Detection and rejection of wine associated odors in wine consumers and experts: effects of delivery matrix and region*

9.25-9.45 Cristina Proserpio (University of Milan, IT)

 *Multisensory food perception: a focus on obese subjects*

9.45-10.05 Rachelle de Vries (Wageningen University, NL)

*Evolutionary tendencies: Multisensory investigations into human food spatial memory biases*

10.05-10.25 Emanuela Maggioni (Sussex University, UK)

 *The Role of the Chemical Senses in the Future of Human-Computer Interaction*

10.25-10.30 Discussion

10.30 – 11.00 *Coffee break*

**11.00 – 12.30 Symposium “Chemosensation”**

Chair: Rachel Herz

11.00-11.05 Introduction

11.05-11.25 Bano Singh (University of Oslo, NO)

 *Chemosensory and trigeminal disorders in patients*

11.25-11.45 Barbara Lieder (University of Vienna, AT)

 *Sensorial evaluation and computational analysis of various sweet tastants*

11.45-12.05 Markus Stieger (Wageningen University, NL)

 *Food oral processing: From structure to behaviour, perception and pleasure*

12.05-12.25 Erna Krusemann (Wageningen University, NL)

*Smelling versus vaping - sensory analysis of e-liquid flavors*

12.25-12.30 Discussion

*12.30-13.30 Lunch and networking opportunities (host Valentina Parma), including* ***poster session***

**13.30-15.00 Symposium “Olfactory receptors, chemical structure and animal models”**

Chair: Veronika Schöpf

13.30-13.35 Introduction

13.35-13.55 Linda Barlow (University of Colorado, USA)

 *Taste cell renewal and cancer therapies*

13.55-14.15 Julia Mohrhardt (RWTH Aachen, DE)

*Infraslow Oscillations in the Mouse Accessory Olfactory Bulb*

14.15-14.35 Ivan Manzini (Justus Liebig University Gießen, DE)

*Olfactory processing in amphibians: a sensory system on the transition from water to land*

14.35-14.55 Silke Sachse (Max Planck Institute for Chemical Ecology, DE)

 *Elucidating olfactory circuits in Drosophila - From odor coding to behavior.*

14.55-15.00 Discussion

15.00 – 15.30 *Coffee break*

**15.30 – 17.00 Symposium “Human clinical olfaction”**

Chair: Valentina Parma

15.30-15.35 Introduction

15.35-15.55 Stina Cornell Kärnekull (Stockholm University, SE)

 *Olfactory memory in blind and sighted individuals*

15.55-16.15 Yaara Endevelt-Shapira (Weizman Institute, IL)

 *Altered responses to social chemosignals in Autism Spectrum Disorder*

16.15-16.35 Cécilia Tremblay (Université du Québec à Trois-Rivières, CAN)

 *Specific chemosensory pattern in patients with Parkinson's disease*

16.35-16.55 Florian Fischmeister (University of Graz, AT)

 *Separating the Neural Correlates of Olfaction in Health and Disease*

16.55-17.00 Discussion

17.00-17.15 Closing remarks (by Veronika Schöpf)

**Friday May 24**

**14.15 – 15.45 “Human olfaction”** (Chair: Valentina Parma)

**Bettina M. Pause**

***Chemosensory contagion of emotions in humans***

Chemosensory contagion of emotion-like states between members of a given species seems to be ubiquitous among the animal kingdom. Such contagious processes often reflect phylogenetically ancient representations of empathy, and are considered to promote individual and group survival. In humans, abundant evidence demonstrates their capacity to effectively process chemosensory anxiety signals emitted by other humans. These signals prime perceptual, neuronal and motor systems in the perceiver, thereby triggering stress-adaptive behavior. Further, this chemical communication is likely to act contagiously, transmitting the related emotions from the sender to the perceiver. The processing of chemosensory anxiety signals does not require attentional mediation; instead, higher-order empathic cognitions are susceptible to effects of subthreshold chemosignals. Chemosensory anxiety signals are preferentially processed in highly anxious individuals; however, in pregnant females, the chemical contagion of anxiety seems to be absent. Recently, first studies indicate that humans also transmit disgust and aggression via the chemical senses. In sum, emotions, transmitted via the chemosensory system, seem to be contagious in humans. During phylogenesis, the core components of empathy might have evolved through communicative competencies within the chemosensory domain.

**Camille Ferdenzi**

***Communication of individual characteristics through human body odor***

One of the main functions of olfaction in numerous species is social communication. In humans, there is evidence that odors conveyed by the body are extremely important in interpersonal relationships. Indeed, we spend a considerable amount of energy every day to control our olfactory image, and we show strong attachment to some individual’s body odors; additionally, losing the sense of smell seriously deteriorates the quality of interactions with our beloved ones. In spite of this, many aspects of social communication through body odors remain to be explored to fully understand this function in humans. This talk presents several studies aiming at better understanding the importance of natural body odors in human social interactions, mostly in a mate choice context. It will mostly focus on sex differences in production and perception of odors conveyed by the body. Results of studies investigating underexplored categories of compounds (carboxylic acids) and odor sources other than the axilla (head odor) will be presented. Finally, this presentation will discuss the current methodological challenges in the field and will propose possible directions for future research.

**Jessica Freiherr**

***Tactile stimuli have the capability to modify odor perception***

Despite plenty recent research on crossmodal integration of various sensory modalities, not much knowledge about crossmodal integration between touch and olfaction is established. In the current experiment, we examined bilateral crossmodal effects of concurrently applied positive and negative tactile and olfactory stimuli in 20 healthy participants (10 women). Therefore, a two-way within-subject experimental design was applied during which either the odor or tactile stimuli was presented first and its influence on the second modality stimulus was tested. We used the positive odors ‘orange’ and ‘cherry’ and the negative odors ‘spoiled fish’ and ‘vomit’, both presented via an olfactometer. Positive tactile stimuli were soft animal-like cloth and fleece and negative tactile stimuli were abrasive paper and a circular hairbrush presented to the hand of the subject using an opaque custom-built box employing a rotatable mechanism. Participants were not informed about the kind of olfactory or tactile stimulus application. Their task was to evaluate pleasantness and intensity of the olfactory (Session 1) and tactile percept (Session 2). Our results indicate that not only positive and negative odors modified tactile perception as reported in other studies but also tactile stimulation altered odor perception. Here, odors were rated significantly less pleasant after negative tactile stimulation and more pleasant after positive tactile stimulation. Since only pleasant odors were influenced by tactile stimuli, unpleasant odor perception appeared to be more conservative or robust than unpleasant tactile perception. This underlines the important role of alert signal perception and processing of potentially harmful negative and unpleasant odors. Olfaction therefore renders superior in comparison to the modality touch with regards to the priority of processing.

**Ilona Croy**

***Nothing is special anymore - the role of olfaction in emotion processing***

Olfactory and emotional higher processing pathways share common anatomical substrates. Hence, depression is often accompanied by alterations in olfactory function. These alterations are negative in nature and may involve decreased activation in olfactory eloquent structures or decreased volume in the olfactory bulb (OB). Olfaction and depression interact in two ways. First, olfactory function in depression is impaired as a consequence of reduced olfactory attention and diminished olfactory receptor turnover rates. Second, the OB may constitute a marker for enhanced vulnerability to depression. Closer analysis of these interactions may help to explain observed experimental data, as well as to elucidate new therapeutic strategies involving olfaction.

**16.15 – 17.15 Keynote lecture** (Chair: Veronika Schöpf)

**Rachel Herz**

***A Brief Review of 30 Years of Olfactory Research***

In this review of 30 years of my olfactory research, I’ll begin by explaining my core findings on the uniquely emotional and evocative nature of odor-evoked memory, and how this has recently led to applied and clinical work on the evaluation of fragranced products and curbing cravings for cigarettes among smokers. I will also delve briefly into my studies on odor context-dependent memory and the role of emotion. I will then explain my work on how odor hedonic responses are formed and how these emotional associations can alter motivated behavior. My emotional learning model will be explained and how it illustrates the truth behind aromatherapy claims described. I will then review various other aspects of my research, including the role of language in odor perception, and body-odor and fragrance in heterosexual attraction. The latter part of my talk will focus on my current research in odor perception that has revealed the influence of circadian phase and time of day, and new data comparing odor and taste perception in normal and overweight adolescents. I will end my presentation by highlighting the multifaceted ways in which olfaction is critical to the quality of life and the toll that anosmia takes.

**Saturday May 25**

**9.00 – 10.30 “Multisensory food perception”** (Chair: Sanne Boesveldt)

**John E. Hayes**

***Detection and rejection of wine associated odors in wine consumers and experts: effects of delivery matrix and region***

Methyl anthranilate (MA) and 2-aminoacetophenone (2AAP) are commonly associated with the flavor of wines made from *V. labruscana* grapes like Concord or Niagara. It is commonly assumed experts and wine consumers find these flavors objectionable, at least in wines vinified from *V. vinifera* grapes. Here, we conducted a series of eight experiments that compared a) orthonasal detection thresholds for MA and 2AAP in various beverage matrices (water, model wine, Riesling), or b) in mouth rejection thresholds for MA and 2AAP in unoaked Chardonnay in different groups who varied in location (Pennsylvania versus California) or expertise (consumers versus experts). Orthonasal detection thresholds for MA and 2AAP were significantly lower in water than in model wine or real wine, recapitulating a need to carefully consider the delivery matrix when comparing threshold estimates across reports. Further, although earlier reports had suggested thresholds for MA and 2AAP differ by two orders of magnitude, we failed to confirm such a difference here: 2AAP thresholds were lower than MA thresholds, but the differences were much smaller than those previously reported. Regarding hedonic responses to MA and 2AAP spiked into a vinifera wine, responses differed across the two odorants, as well as with location and expertise. Participants included wine experts from California, and non-expert wine consumers in California and Pennsylvania. Consistent with the expectation that experts see these odors as a fault, wines with high MA concentrations were rejected by the wine experts. However, non-expert consumers in California were far more tolerant of added MA, and non-expert consumers in Pennsylvania showed little to no influence of added MA on preferences. In contrast, 2AAP failed to elicit rejection in either wine experts or California consumers at concentrations tested. These data suggest 2AAP should not be a major concern for commercial wine producers, despite the lower threshold.

**Cristina Proserpio**

***Multisensory food perception: a focus on obese subjects***

Food perception and food acceptability are the result of multiple sensory modalities, including visual, olfactory, gustatory, and somatosensory inputs. Some evidence suggests that obese subjects are more prone to be affected by sensory cues than lean subjects. In particular, individuals characterized by higher body mass index (BMI) seem to be associated with a higher susceptibility to external stimuli, such as odor cues. Indeed, among food cues that have an established function in eating behavior, food odors have a key role in affecting food choices, appetite and food consumption.

Recent results from our research group showed that multisensory interactions (odor-taste-texture) occur differently according to BMI and, to a lesser extent, to gender. Indeed, the use of aromas and thickener agents in model food, such as a custard dessert, produced stronger sensory interactions (odor-taste, odor-flavor and odor-texture) in subjects with higher BMI, especially in women, compared to the normal-weight subjects. In particular, the addition of an olfactory stimulus signaling high-calorie products, such as butter aroma, modified the perception of different sensory characteristics in a more effective way in obese subjects compared to the control group. Interestingly, subjects with higher BMI perceived the modified samples, added with butter aroma, as sweeter without a real addition of sugar.

It seems evident that applying a sensory approach is noteworthy in order to deepen the study of the complex issue of overeating. Indeed, it is possible to hypothesize that sensory cues, especially odors, could affect food perception and consequently food consumption. How the mechanism of brain integration occurs in subjects with different nutritional status should be envisaged to develop new food products with a reduced caloric intake but which are still satisfying for the consumers.

**Rachelle de Vries**

***Evolutionary tendencies: Multisensory investigations into human food spatial memory biases***

Large differences exist in how individuals respond to the modern food environment, with some better at navigating tempting surroundings and maintaining a healthy energy balance. We investigated whether biases in human food spatial memory exist and partially account for this individual variation. In two lab studies with distinct samples of 88 participants, individuals had to re-locate foods on a map in a computer-based spatial memory task using visual (Study 1) or olfactory (Study 2) cues that signaled sweet and savory high- and low-calorie foods. Individuals consistently displayed an enhanced memory for locations of high-calorie and savory-tasting foods – regardless of hedonic evaluations, personal experiences with foods, or the time taken to encode food locations. Findings indicate an automatic cognitive system presumably attuned to ancestral priorities of optimal foraging. Although we did not find any clear effects of high-calorie and savory-taste biases in food spatial memory on eating behavior, results highlight novel directions for future work. Finally, insights from a multisensory field investigation at the Lowlands 2018 music festival regarding the existence of these biases in human food spatial memory will be discussed.

**Emanuela Maggioni**

***The Role of the Chemical Senses in the Future of Human-Computer Interaction***

The human sense of taste and smell have become a target for interaction design and Human-Computer Interaction (HCI) research. While fields such as sensory science, chemistry, and biology have advanced our understanding on sensory perception, the interactive experiences that can be created based on taste and smell remain widely unexplored within HCI. We have only recently started to understand the dimensions and features of taste and smell for multisensory experience design. However, we still lack guidance on which of those dimensions/features are relevant to account for in multisensory interaction and experience design. Hence, in order to inform the design of future gustatory, olfactory, and ultimately multisensory interfaces/interactions we need to establish a more detailed understanding of the design space for taste and smell in relation to technology.

Here we present OWidgets, a toolkit to enable olfactory experience design. Several odour-delivery devices have been developed but they are linked to single applications or proprietary software. These devices and software solutions do not allow for replicable olfactory experience design. Therefore, the interaction design community is missing out on many opportunities to improve interactions through olfactory stimulation. We propose a device-independent software solution which enables the creation and replication of olfactory experiences, identifying a set of olfactory design features. We discuss the relevance of OWidgets and the opportunities emerging through a device-independent toolkit for olfactory experience design. We highlight remaining challenges and future directions to extend and integrate the toolkit into the wider audio-visual ecosystem.

The aim of this talk is to share some of the challenges and opportunities for multisensory HCI based on the research we conduct at the SCHI ‘sky’ Lab at the University of Sussex.

**11.00 – 12.30 “Chemosensation”** (Chair: Rachel Herz)

**Preet Bano Singh**

***Chemosensory and trigeminal disorders in patients***

Smell and taste disturbances are quite frequent in the general population and even more pronounced in certain groups of patients such as cancer patients, patients with Parkinson’s disease etc. A survey conducted on American population above 40 years showed that 13.5% of the American adults have olfactory dysfunction and 17.3% have gustatory dysfunction. However, patients with chemosensory disorders remain frustrated, due to the lack of appropriate medical attention and care. This may partly be a result of a lack of knowledge and focus on appropriate tools required to assess disorders involving chemical senses among medical practitioners. The presentation will provide an introductory overview of various causes of chemosensory and trigeminal disorders, standard tools required to diagnose, and specific forms of treatments. In addition, a questionnaire that we developed to assess (i) patient’s chemosensory and trigeminal disorders, (ii) their duration, (iii) their effect on food preferences, and (iv) the effect on patient’s quality of life, will be presented. This questionnaire may be helpful for health professionals in getting an overview of patients’ oral disturbances. This will further be beneficial in managing patients’ dietary intake. I will highlight recent clinical findings exhibiting chemosensory and trigeminal disorders in different groups of patients at Dry Mouth Clinic, University of Oslo.

**Barbara Lieder**

***Sensorial evaluation and computational analysis of various sweet tasting compounds***

In times of growing obesity as a consequence of an unhealthy life style including eating habits, there is an increasing trend for sugar-reduced products. However, the currently used alternative sweeteners have a sensorial profile which is distinct from sugar, limiting consumer’s acceptance. So far, the molecular mechanisms which determine the sweet perception and undesired side-tastes, such as metallic and astringent taste, are not well understood. Thus, the aim of the present study was to identify structural and physicochemical descriptors of sweet tasting compounds that determine their sensorial attributes.

Hence, 34 sweet tasting compounds (dissolved in tap water to a concentrations equi-sweet to 5% sucrose) were profiled by a descriptive panel (n≥8; 2 reps). Furthermore, physiochemical attributes including molecular weight, viscosity, sweetness factor, topological polar surface area, mlogP, complexity, length of glycons and alkyl chain, and the total number of: rotatable bonds, heavy atoms, C-atoms, double-bonds, OH-groups, ketones, bounded glucose, aromatic rings, stereo centers, hydrogen bond donors and acceptors, were calculated with MedChemDesigner 3.1.0.30, taken from pubchem database (August 2018) or analyzed experimentally (viscosity by rotating viscometer Physica SM, Anton Paar).

A cluster analysis of the compounds revealed a tendency towards more complex sweeteners to be associated with more off-notes. In addition, the undesired attributes are positively correlated with the number of rotatable bonds and heavy atoms. The sweetness factor in relation to 5% sucrose was associated with a higher onset, mlogP, and the amount of double-bonds, ketones and aromatic rings. Moreover, a multivariate analysis demonstrated interactions between several descriptors as a driving force for sweetness.

The present study provides a sensorial comparison of 34 sweet tasting compounds and reveals some new findings regarding the structural-based driving forces of sweetness.

**Markus Stieger**

***Food oral processing: From structure to behaviour, perception and pleasure***

Food oral processing as the bridge between transformation of food structure during consumption, eating behaviour, sensory perception and food acceptability has gained enormous interest in the last decades. An overview of the interplay between food structure, oral processing and eating behaviour, sensory perception and hedonic evaluation of foods is provided comparing different consumer groups.

It is demonstrated that food oral processing depends on both food properties and consumer characteristics. Consumers strongly adapt oral processing behaviour with respect to bite size, consumption time, and eating rate to rheological and mechanical properties of liquid, semi-solid and solid foods. Liking and familiarity influence oral processing behaviour, but by a considerable lower degree than rheological and mechanical properties. Correlations between instrumental texture properties of solid foods and oral processing behaviour provide guidance on parameters that are likely to produce ‘faster’ and ‘slower’ versions of foods. This demonstrates how food texture modifications can be applied to moderate eating rate and energy intake.

It is shown how age, gender, and ethnicity affect oral processing behaviour of liquid, semi-solid and solid foods differently. Consumer groups adapt eating rate in different ways by modifying bite size, consumption time or both. Parameters describing oral physiology explain differences in oral processing behaviour between groups only to a limited extend. Other oral physiological and cultural factors might contribute more to differences in oral processing behaviour between groups. While age, gender and ethnicity can influence oral behaviour, bolus properties do not necessarily differ between groups suggesting that although oral behaviour may vary somewhat between groups, similar bolus properties can be reached. However, large differences in oral behaviour between groups (fast and slow eaters) lead to considerable differences in bolus properties leading to differences in sensory perception and food intake.

**Erna J.Z. Krüsemann**

***Smelling versus vaping - sensory analysis of e-liquid flavors***

Flavor variety is an important reason for smokers to switch to electronic cigarette (e-cigarette) use. However, the availability of attractive e-liquid flavors may also stimulate e-cigarette use among young non-smokers. Research on e-liquid flavor liking in both user groups is necessary to inform regulators and protect public health. Sensory research on e-liquids can be performed by means of smelling and vaping. Compared to vaping, smelling is faster, less expensive, less invasive and thus associated with fewer restrictions on the study population. However, data on the comparability of smelling and vaping is lacking. This study aims to determine the correlation in hedonic flavor assessment between smelling and vaping e-liquids, for smokers and non-smokers.

Twenty-four smokers (mean age 24.8±9.3) and twenty-four non-smokers (mean age 24.9±7.7), all having never used an e-cigarette, smelled and vaped 25 e-liquids in various flavors. Participants assessed liking, intensity, familiarity, and irritation on a 100 mm Visual Analogue Scale. Correlation coefficients within and between smelling and vaping were calculated. Differences between smokers and non-smokers were calculated using t-tests.

Mean flavor liking ranged from 20.9±13.6 to 68.4±14.3 (smelling) and from 24.5±19.7 to 64.8±22.3 (vaping). For the whole group, correlation coefficients between smelling and vaping for the mean ratings were 0.84 for liking, 0.82 for intensity, 0.84 for familiarity, and 0.73 for irritation. The mean within-subjects correlations were respectively 0.51, 0.37, 0.47, and 0.25. Between smokers and non-smokers, no significant differences in correlations and in mean liking ratings were found.

Liking of e-liquid flavors by smelling strongly correlates with vaping scores (real consumer behavior). Thus, smelling experiments could be used to further investigate differences in flavor liking between consumer groups, taking potential differences on individual and flavor level into account.

**13.30-15.00 “Olfactory receptors, chemical structure and animal models”** (Chair: Veronika Schöpf)

**Linda A. Barlow**

***Elucidating the mechanisms of head and neck radiotherapy-induced taste disruption in a mouse model of fractionated irradiation***

Head and neck cancer patients receiving conventional fractionated radiotherapy (daily treatment for up to 7 weeks) suffer from taste dysfunction and xerostomia that persists months to years and can lead to weight loss and poor clinical outcomes, and long term reduced quality of life. To understand the cellular and molecular mechanisms underlying functional taste loss, we established a fractionated irradiation mouse model, where the head and neck of mice is exposed to 4Gy daily for 5 days. Like patients, mice have reduced taste perception and lose weight following radiation treatment, which both gradually recover. We next investigated at the cellular level how irradiation affects taste buds on the tongue. Normally, taste cell progenitors adjacent to taste buds proliferate and give rise to cells that enter taste buds and differentiate into Type I, II or III taste cells (glial-like, sweet/bitter/umami receptors or sour/high salt detectors, respectively). In irradiated mice, proliferation of progenitors was reduced by repeated irradiation, and taste buds were markedly smaller, consistent with the failure of progenitors to generate new taste cells. More specifically, we detected fewer Type II cells and a trend toward fewer Type III cells compared to controls, and marker gene expression for all 3 taste cell types was significantly reduced by irradiation. Previously following a single irradiation dose, we found progenitor cell death was increased 10 fold compared to controls. However, following fractionated radiation, we observed a significant increase in dying cells within taste buds, suggesting that in addition to dividing progenitors, differentiated taste cells are prone to DNA damage-induced death when exposed to repeated irradiation doses. We next sought to understand how the Wnt/ß-catenin pathway, a key regulator of taste progenitor proliferation, is affected by fractionated radiation. Expression of 2 effectors of the pathway, β-catenin and Lef1, were reduced concomitantly with reduced proliferation in response to irradiation. Following the last fractionated dose, however, progenitor proliferation is upregulated demonstrating a classic response to radiation injury; yet upregulation of Wnt signaling lags behind proliferative recovery implicating an as-yet-to-be identified signaling pathway in driving resumption in progenitor proliferation. By contrast, Wnt signaling recovers in advance of the recovery of taste bud size and cell type complement, consistent with demonstrated role of the Wnt pathway in taste cell differentiation. These findings suggest that carefully timed regulation of Wnt signaling during and immediately following fractionated radiotherapy may offer a way to mitigate taste dysfunction for patients.

**Julia Mohrhardt**

***Infraslow Oscillations in the Mouse Accessory Olfactory Bulb***

The accessory olfactory bulb (AOB) represents the first stage of information processing in the rodent accessory olfactory system. In the AOB, mitral cells receive sensory input from peripheral vomeronasal neurons. This sensory information is (pre-)processed in the AOB and relayed to third- and fourth-order nuclei in the amygdala and hypothalamus.

In both in vitro and in vivo experiments, we investigate patterns of spontaneous neuronal activity in AOB mitral cells (AMCs). Recently, we demonstrated that a subpopulation of AMCs is intrinsically rhythmogenic and exhibits slow stereotypical oscillatory discharge. Using voltage- and current-clamp whole-cell recordings in acute AOB tissue slices from C57BL/6 mice, we now identify an excitatory circuit within the AOB that entrains oscillatory activity in a second AMC subpopulation. These neurons display periodically increased synaptic input that correlates with their respective rhythmic discharge patterns. Blocking fast glutamatergic synaptic transmission reveals that, in a subgroup of AMCs, entrainment largely depends on an intact glutamatergic network. By contrast, a second subpopulation of entrained AMCs appears insensitive to pharmacological inhibition of glutamatergic input.

Ongoing patch-clamp and optogenetic experiments now aim to identify the exact physiological mechanisms of oscillatory entrainment and synchronization. Together, our long-term goal is to gain a detailed mechanistic understanding of slow synchronous oscillatory discharge in the mouse AOB and thus to dissect the functional role of such rhythmic activity in information processing along the accessory olfactory pathway.

**Ivan Manzini**

***Olfactory processing in amphibians: a sensory system on the transition from water to land***

A dramatic ecological change in evolution was the late Devonian water to land transition. To survive on the threshold between these two media, amphibians developed a sense of smell able to detect both water- and airborne odorants. In addition to being at an evolutionary transition, amphibian lives are also biphasic. Most amphibians have aquatic larvae that transform into terrestrial adults, a metamorphosis that requires major adaptations to the olfactory system. The three orders of extant amphibians (Anura, Caudata, Gymnophiona) have radiated into a plethora of habitats, from aquatic to terrestrial and arboreal. It remains elusive how the diverse ecological demands reflect on the functionality of the olfactory system.

Our research on the olfactory system of the pipid frog *Xenopus laevis* (order Anura) has highlighted several interesting molecular, structural and functional peculiarities in comparison with the system described in other vertebrates, especially mammals. To understand the relevance of the olfactory network properties found in *Xenopus laevis* for their life on the transition from water to land, we performed research along two axes. We compared the olfactory network properties in different amphibian and fish species with the existing knowledge on terrestrial mammalian olfaction, and investigated how the olfactory network in amphibians is reshaped during the metamorphosis to match the changing ecological demands.

**Silke Sachse**

***Elucidating olfactory circuits in Drosophila - From odor coding to behavior.***

Animals use sensory systems to navigate the environment in a way that optimizes their survival and reproduction. The olfactory system plays here a key role in encoding chemical information and translating the outside world into a neuronal representation that enables an animal to take odor-guided decisions. My group is investigating how odors are encoded and processed in the *Drosophila* brain to lead to a specific odor perception. The vinegar fly represents a premier model system for studying olfactory processing mechanisms since it exhibits a stereotyped architecture which is similar to its mammalian counterpart, but is less complex and highly tractable as well as susceptible to genetic manipulations. By exploiting these genetic techniques and linking them to neurophysiological, molecular and behavioral methods, we are dissecting the neural circuits that are involved in coding, processing and perception of odors. As a key method, we are using functional imaging to monitor activity patterns elicited by odors in the antennal lobe, the first olfactory neuropil, as well as in higher processing centers, such as the lateral horn. Moreover, we employ genetic tools to selective trace individual neurons for anatomical reconstructions. The talk will summarize our recent insights into coding strategies of the olfactory system regarding odor identity, hedonic valence as well as odor intensity.

**15.30 – 17.00 “Human clinical olfaction”** (Chair: Valentina Parma)

**Stina Cornell Kärnekull**

***Olfactory memory in blind and sighted individuals***

Blindness may lead to enhanced memory in the intact non-visual senses, such as audition. However, little is known about the effect of blindness on the chemical senses. In three studies, we studied episodic recognition of odors and sounds in blind and sighted individuals. The first study targeted memory after a short retention interval and showed that odor recognition performance was similar for early blind (n = 15), late blind (n = 15), and sighted controls (n = 30). In contrast, sound recognition was significantly better in early blind than in sighted, whereas the late blind did not differ significantly from either of the groups. These findings suggest that auditory but not olfactory episodic memory is affected by blindness and that the onset age of blindness matters. In the second study, the same participants (14 early blind, 13 late blind, and 30 sighted) were followed-up approximately a year after the initial test. The three groups now performed similarly at both the odor and sound recognition tasks, suggesting that the early blind individuals’ advantage is specific for short time frames. The third study examined whether also autobiographical memory, specifically the reminiscence bumps, may differ between blind and sighted individuals. Here, early blind (n = 31) and sighted controls (n =31) were cued with odors and sounds to evoke personal memories. The temporal distributions of memories across the life-span were similar for the groups. The blind and sighted participants demonstrated an olfactory bump (i.e., peak of memories) in early childhood and similar temporal distributions for sound-evoked memories. Moreover, although blind individuals retrieved somewhat more odor- and sound-evoked memories than the sighted, there were no statistically significant group differences. These findings suggest that the reminiscence bump is robust to changes in sensory function. Taken together, episodic odor memory does not seem to be affected by blindness.

**Yaara Endevelt-Shapira**

***Altered Responses to Social Chemosignals in Autism Spectrum Disorder***

Social chemosignals are volatiles secreted by one individual to affect the behavioral, physiological, brain activity and hormonal state of other individuals. A Growing body of evidence implies that social chemosignals likely play a major role in human social interaction, mostly without conscious awareness. Because Autism spectrum disorder (ASD) is characterized by impaired social communication, often attributed to misreading of emotional cues, we hypothesized that misreading of emotional cues in ASD partially reflects altered social chemosignaling.

In a series of experiments, we investigated this hypothesis by comparing the physiological and behavioral responses of typically developed (TD) adults and cognitively able adults with ASD to the subliminal presentation of social chemosignals. In the first two experiments, we tested the effects of *smell of fear* (actual body-odor collected from first-time tandem skydivers). Then, we tested the impact of two different isolated putative social chemosignals.

Experiments with subliminal presentation of a natural stimulus (*smell of fear*) and two different synthetic putative social chemosignals converged to imply altered autonomic and behavioral responses to social chemosignals in ASD, emphasizing the critical role of chemosignaling in human social interaction and communication and its disruptions in cases of social disorders.

This may give rise to a condition we term *Social Dysosmia*. We speculate that *Social Dysosmia* may underlie part of the impaired reading of emotional cues in ASD. This speculation suggests novel paths of research, diagnosis, and treatment.

**Cécilia Tremblay**

***Specific chemosensory pattern in patients with Parkinson’s disease***

Olfactory dysfunction is a highly sensitive non-motor symptom of Parkinson’s disease (PD) present in more than 90% of patients that appears several years before the appearance of motor symptoms. In order to use olfactory testing to screen for PD, it is important to differentiate olfactory dysfunction associated with PD from other olfactory dysfunctions (such as olfactory loss related to sinunasal disease, viral infection, trauma). One potential avenue to do so is the measurement of the trigeminal sensitivity. While there is evidence that patients with olfactory dysfunction show a reduced trigeminal sensitivity compared to controls, previous studies suggested that the trigeminal system does not seem to be impaired in PD.

Our objective was, therefore, to investigate the trigeminal pathway by measuring peripheral (from the mucosa, negative mucosal potential, NMP) and central (event-related potential, ERP) electrophysiological responses to the trigeminal stimulus carbon dioxide in patients with Parkinson's disease and compare them to patients with non-parkinsonian olfactory dysfunction and to healthy controls. Our results show that patients with non-parkinsonian olfactory dysfunction show longer NMP latencies and amplitudes than controls and patients with Parkinson’s disease. Moreover, PD patients show larger ERP components than patients with non-parkinsonian olfactory dysfunction. This was despite the fact that olfactory function was significantly diminished in both groups of patients compared to controls. These results revealed a discriminant model that could predict group membership for 80% of participants based on the negative-mucosa-potential-latency, olfactory threshold and discrimination tests. These results provide novel insights on the pattern of trigeminal activation in PD which will help to differentiate PD-related olfactory loss from NPOD, a crucial step towards establishing early screening batteries for PD including smell tests.

**Florian Ph.S Fischmeister**

***Separating the Neural Correlates of Olfaction in Health and Disease***

Human odor perception relies on the tight interplay between the olfactory system and the trigeminal system since most odorants stimulate both systems simultaneously, although to varying degrees. Interestingly, although not able to perceive the odorant itself, acquired anosmia patients are still aware of trigeminal components of odorants and often can use them to identify the odor. Additionally, odor perception is modulated by breathing pattern and breathing pace as well as by expectancy, all of which also significantly affect neuronal activity.

Here we investigate the possibility to separate these components of odor perception in normosmic and anosmic participants using a pseudo-free breathing paradigm. In this fMRI study participants had to performed a simple guided breathing experiment where they had to match their breathing cycle to an expanding or shrinking ball. During some of the inhale-phases olfactory stimuli (rose or peppermint), or diluted carbon dioxide (CO2) as pure trigeminal stimulus were presented.

Results show that olfactory stimuli compared to guided breathing exhibited stronger and more distinct activation within both piriform cortices as well as within the parahippocampal and entorhinal cortices, both not found in the direct contrast. In anosmic participants, a similar pattern evolved, however, at a very lean threshold. CO2 on the other side activated somatosensory regions, yet comparing CO2 to breathing, revealed additional strong activations within the insular cortex and the supramarginal gyrus in all participants. Breathing itself activated expected areas within the basal ganglia, cerebellum, and frontal areas.

These results further previous literature and emphasize the importance of the tight control of respiration pattern as an essential part of olfactory perception.

**Poster session Saturday May 25, 12.30-13.30**

(listed in alphabetical order)

**Marieke Alblas and Joleen Boland**, Wageningen University, the Netherlands

*Effect of multisensory cues on saliva secretion and its properties*

**Cinzia Cecchetto**, University of Graz, Austria

*Social odor context enhances encoding and recognition of faces*

**Arabella Ellenbroek**, Wageningen University, the Netherlands

*The influence of macronutrient-related odours on sensory specific appetite and subsequent food intake*

**Ilona Owusu**, Innovatrice in Healthcare, founder of NoseMe.com, the Netherlands

*On the development of a smell training app for anosmics*

**Caro Verbeek**, Vrije Universiteit Amsterdam, the Netherlands

*In Search of Lost Scents – A Futurist Scentscape*

**Marta Zakrzewska**, Stockholm University, Sweden

*An overprotective nose? Body odor disgust sensitivity and social attitudes*

*During coffee and lunch breaks, Cynexo will demonstrate their newly developed olfactometer*