Clincial Chemosensation 2014

The International Meeting of the Committee on Olfaction and Gustation of the German Society of Otorhinolaryngology, Head and Neck Surgery

Program and abstracts

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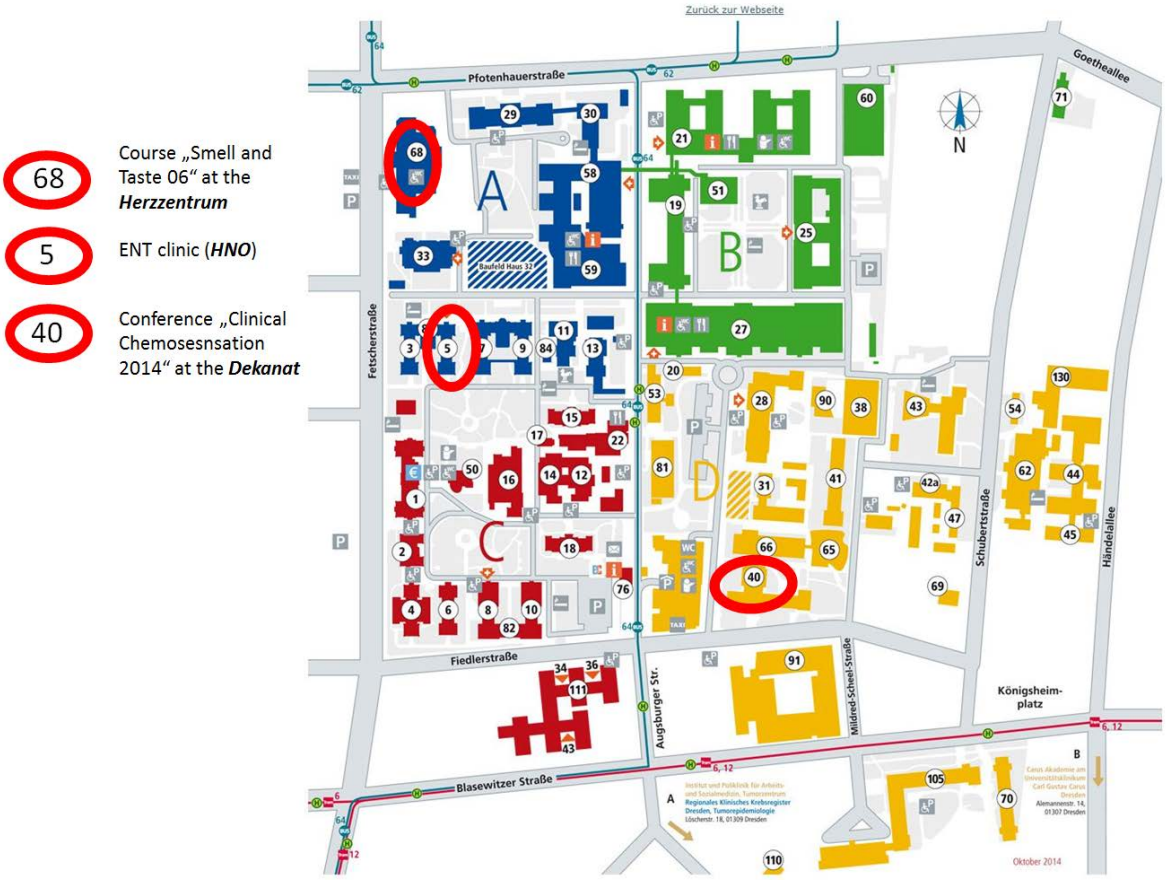
Clincial Chemosensation 2014

The International Meeting of the Committee on Olfaction and Gustation of the German Society of Otorhinolaryngology, Head and Neck Surgery

The meeting is going to take place in Dresden, Germany. It will begin on Friday afternoon, **November 21th**, and end on Sunday afternoon, **November 23rd,** of **2014**.

The conference venue will be the lecture hall ("Hörsaal") at the DEKANAT building at Fiedlerstrasse 27.
Help desk telephone number: +49- 1515 1107454
The meeting is organized by the Smell & Taste Clinic of the Department of Otorhinolaryngology of the TU Dresden, Fetscherstrasse 74, 01307 Dresden, Germany; phone +49-351-458-4189



Program at a glance

	Friday	Saturday	Sunday
08:00		German, Austrian and Swiss	International Committe
08:15		Working group on	on Smell and Taste
08:30		Olfaction and gustation	
08:45			
09:00			
09:15			
09:30		Registration	Registration
09:45		Moh&Charl	Moh&Charl
10:00		Lundstrom	Lötsch
10:15			
10:30			Vodicka
10:45		Schriever	Gudziol
11:00		Altundag	Grushka
11:15		Renner	Stuck
11:30		de Graaf	
11:45			break
12:00		break	
12:15			Chen
12:30		Wilson	
12:45			Iannilli
13:00			Müller
13:15		Coppin	Ohla
13:30			Seubert
13:45	Registration	break (salads, sandwiches)	Sinding
14:00	Mohammed	/ posters	farewell
14:15	Charlotte		
14:30		Ulrich & Olbricht	
14:45	welcome		
15:00	Doty	poster	
15:15			
15:30			
15:45	Hähner		
16:00		Larsson	
16:15	Foguem		
16:30		Freiherr	
16:45	break	Olofsson	
17:00			
17:15	Büttner	Pichon	
17:30			
17:45	Margot	city tour	
18:00			
18:15	Schmuker		
18:30			
18:45	Croy		
19:00			
19:15	Bensafi		
19:30		dinner	
19:45	pretzels		
20:00	and beer		
20:15			
20:30		ends approx. 23:00h	

Program - Friday, 21st of November

13:45-14:45 Registration
14:45-15:00 Welcome

15:00-16:45 Neurodegeneration and the Chemical Senses
Chair: Antje Welge-Lüssen, Basel

15:00-15:45 Olfactory Function in Neurological Diseases
Richard L Doty, Philadelphia
15:45-16:15 Olfactory training in Parkinson´s disease
Antje Haehner, Rauber C, Wegener B, Croy I, Hummel T; Dresden
16:15-16:45 Olfaction in Dementia with Lewy Body and in Parkinson Dementia: Discrimination by sensitivity
Clovis Foguem, Schaal B, Brand G; Dijon, Epernay, Besancan

16:45-17:15 break

17:15-19:45 Odor spaces
Chair: Charlotte Sinding, Dresden

17:15-17:45 Balsamic, indulgent and well-being inducing smells – in search of chemical and physiological traces
Andrea Buettner, J. Beauchamp, A. Kessler, J. Niebler, H. Sahin, C. Villmann; Munich, Erlangen
17:45-18:15 What is musk?
Christian Margot, Geneva
18:15-18:45 Exploring the chemical map in the olfactory bulb
Michael Schmuker, Berlin
18:45-19:15 Specific anosmia as a principle of olfactory perception
Ilona Croy, Selda Olgun, Laura Mueller, Anna Schmidt, Marcus Muench, Guenter Gisselmann, Hanns Hatt, Thomas Hummel; Dresden, Bochum
19:15-19:45 Olfactory spaces: relating chemical and perceptual spaces to neural activity
Moustafa Bensafi , Lyon

19:45-20:45 Pretzels and beer etc. – get together

Program - Saturday, 22nd of November

8:00-9:30 Meeting of the "German, Austrian and Swiss Working Group on Olfaction and Gustation"
Chair: Karl-Bernd Hüttenbrink, Cologne
The language in this specific session will be German; topics will relate to

- Guidelines for diagnostics and treatment smell and taste disorders
- How to test taste?
- Is normosmia the same as a normal sense of smell?
- Travelling grants for colleagues inrerested in smell and taste
- Elections in 2015

9:30-10:00 Registration

10:00-12:00 Plasticity in the chemical senses
Chair: Basile Landis, Geneva

10:00-10:45 Rapid and context-dependent plasticity of human olfactory functions
Johan Lundström; Philadelphia, Stockholm

10:45-11:00 Exposure to odors improves olfactory function in children
Valentin Schriever, Mori E, Petters W, Valder C, Hummel T; Dresden, Henstedt-Ulzburg, Tokyo

11:00-11:15 Modified olfactory training in patients with postinfectious olfactory loss
Aytug Altundag; Istambul

11:15-11:30 Laterality and onset of olfactory evoked magnetic fields in the human brain
Renner B, Kaltenhäuser M, Staudacher G, Grosskopf A, Neuhuber W, Buchfelder M, Brandner S, Stadlbauer A; Erlangen

11:30-12:00 The role of taste and smell in the regulation of food intake in healthy individuals and in individuals with taste and/or smell disorders
Kees de Graaf; Wageningen

12:00-12:30 break

12:30-13:30 Olfaction in disease and eating
Chair: Maria Larsson, Stockholm

12:30-13:15 Olfaction in animal models of disease
Don Wilson, New York

13:15-13:45 Flavor-nutrient conditioning is altered in overweight individuals
Coppin G, Wray AE, Veldhuizen MG, Small DM; New Haven

13:45-14:30 lunch break / posters
Salads, sandwiches, apples, softdrinks etc. will be availbale

14:30-15:00 Food production
Chair: Volker Gudziol, Dresden

14:30-15:00 Domestication effect and sensory value in strawberry - Breeding the flavour out of our fruits?
Detlef Ulrich, Klaus Olbricht; Quedlinburg, Dresden

15:00-16:00 Posters – during this time all presenters are at the posters; posters should be put up at the beginning of the conference.
The best posters will be selected by Antje Haehner (Dresden), Basile Landis (Geneva), Boris Stuck (Mannheim), Antje Welge-Luessen (Basel), and Martin Witt (Rostock) – **the poster price will be 100 Euro.**

16:00-17:45 Olfaction and Cognition
Chair: Ilona Croy, Dresden

16:00-16:30 Olfactory memory is separate from other forms of memory in the old and very old: Evidence from a population-based study
Larsson M, Laukka EJ, Hedner M, Bäckmann L; Stockholm

16:30-16:45 Targeting the brain through the nose: effects of an intranasal insulin application on human olfactory perception and memory processes
Freiherr J, Brünner YF, Benedict C; Aachen

16:45-17:15 A designated odor-language integration system In the human brain
Olofsson JK, Hurley RS, Bowman NE, Mesulam MM, Gottfried JA; Chicago, Stockholm, Uppsala

17:15-17:45 My mind is elsewhere but my nose stays focused: effects of attention and emotion on olfactory perception.
Aline Pichon, Kalliopi Apazoglou, Sylvain Delplanque, Christian Margot, David Sander, Patrik Vuilleumier; Geneva

17:45 tram transfer (free tickets) from the conference venue to the Pirnaischer Platz led by Agnieszka Sorokowska

18:00-19:30 Guided tours (in English) through the historic center

19.30-23:30 Dinner at the Kanonenhof, beneath the Bruhlsche Terrassen in the historical center (Brühlscher Garten 4) - please see maps in your conference bag -
We will have an alcohol restriction in place meaning that the welcome drink plus the first alcoholic drink are free; for all other alcoholic beverages people have to pay for themselves.

Program - Sunday, 23rd of November

8:00-9:30 Meeting of the "International Committee on Smell and Taste"
Chair: Thomas Hummel, Dresden
The idea would be to set the foundation for an international consensus paper on human olfactory function, olfactory dysfunction, diagnostics and treatment, e.g., what is parosmia, how do we define anosmia etc.

9:30-10:00 Registration

10:00-11:45 Human olfaction in disease
Chair: Antje Welge-Lüssen, Basel

10:00-10:30 Drug effects on human olfaction
Jörn Lötsch; Frankfurt

10:30-10:45 Different smell ability in subjects with anomia
Vodicka J, Brothankova P; Pardubice

10:45-11:00 Olfactory function in Aspirin tolerant and intolerant patient with chronic rhinosinusitis- a prospective study
V. Gudziol, C. Sonnefeld, T. Hummel, D. Koschel; Dresden

11:00-11:15 Does Sjogren's syndrome affect odor identification abilities?
Grushka M, Su N, Poon R; Toronto

11:15-11:45 Olfaction in Allergic Rhinitis - A Systematic Review
Stuck BA; Mannheim

11:45-12:15 break

12:15-14:00 Binaral smelling, Taste, and Pain
Chair: Martin Witt, Rostock

12:15-12:45 Binaral olfaction sharpens sense of smell
Denise Chen, Jin Wang; Houston

12:45-13:00 Gustatory cortex and its dynamical processing
Emilia Iannilli; Dresden

13:00-13:15 Gustatory Function in Patients with Chronic Rhinosinusitis
Mueller CA, Wolf A, Renner B; Wien, Graz, Erlangen

13:15-13:30 Dynamic coding of different tastes in the human brain
Ohla K; Berlin

13:30-13:45 Superadditive processing of food flavor is modulated by insular and entorhinal cortex connectivity
Seubert J, Ohla K, Fondberg R, Yokomukai Y, Kellermann T, Lundström JN; Stockholm, Philadelphia, Potsdam-Rehbrücke, Aachen, Tokyo

13:45-14:00 Part of the pain matrix is thicker in patients with Burning Mouth Syndrom
Sinding C, Gransjøen AM, Schlumberger G, Singh PB, Hummel T; Dresden, Oslo

14:00-14:15 Announcement of the best posters

14:15 Farewell

Posters with poster numbers

On Saturday, from 15:00-16:00 all presenters should be at the posters; posters should be put up at the beginning of the conference. The best poster will be selected by Antje Haehner (Dresden), Basile Landis (Geneva), Boris Stuck (Mannheim), Antje Welge-Luessen (Basel), and Martin Witt (Rostock): **The prize will be 100 Euro.**

Aging and the chemical senses

1. **Olfactory event-related potentials in children and adolescents:** *Carolin Boerner,* Thomas Hummel*,* Eri Mori, *Valentin Alexander Schriever; Dresden, Tokyo*

2. **Olfactory training with older people:** Wegener BA, Croy I, Hähner A, Hummel T; Dresden
3. **The Sense of Smell in Old Age - Preliminary Results:** Nováková LM; Prague
4. **Changes in Smell and Taste Function in the Elderly:** Takaki Miwa, Junpei Yamamoto, Kanako Teraguchi, Yuko Kinoshita, Kentaro Ymamda, Takuya Noda, Masayuki Harita, Hideaki Shiga, Eriko Sugiyama, Kaori Ono, Misako Kawai; Kanazawa
5. **Ageing effect on gustatory function: a high density channels event-related potentials study:** Kunz S, Broy F, Hummel C, Hummel T, Iannilli E; Dresden

Treatment of olfactory loss

6. **Short-term effect of caffeine on olfactory function:** Albinus J, Meusel T, Welge-Luessen A, Hähner A, Hummel T. Dresden, Erlangen, Basel

7. **The effect of acupuncture on olfactory function in patients with post-infectious smell loss:** Gewald B, Hauswald B, Hähner A; Dresden
8. **"Kaiteki" position to reach the olfactory cleft for the nasal drops:** Eri Mori, Christos Merkonidis, Mandy Scheibe, Volker Gudziol, Thomas Hummel; Tokyo, Dresden, London

Social phenomena

9. withdrawn
10. **Expecting women keeping cool: Pregnancy prevents the chemosensory transmission of anxiety:** Katrin T. Lübke, Anne Orth, Matthias Hoenen, Benoist Schaal, Bettina M. Pause; Düsseldorf, Dijon
11. **Influence of HLA correspondence in partnership and sexuality:** Kromer J, Pietrowski D, Giani A, Schmidt R, Ehninger G, Hummel T, Croy I; Dresden, Tübingen
12. **Men and Women React Differently to Room Fragrances:** Henriette Maaß, Ilona Croy, Thomas Hummel, Antje Haehner; Dresden
13. **Odor processing after mood induction** – Elena Erwin, Thomas Hummel, Ilona Croy; Dresden

Parameters of olfactory testing

14. **Sequential context effects on odor pleasantness rating:** Nakano S, Ayabe-Kanamura S; Tsukuba
15. **Determinants of human olfactory performance: a cross-cultural study:** Sorokowska A, Sorokowski P; Wroclaw, Dresden
16. **Configural and elemental abilities in adults with autism:** Pflug K, Sinding C, Arshamian A, Coureaud G, Thomas-Danguin T, Bensafi M, King J, Ehrlich S, Hummel T; Dresden, Lyon, Dijon, Stockholm
17. **Decreased olfactory threshold, identification, and discrimination in the Down syndrome:** Cecchini MP, Sandri M, Viviani D, Hummel T, Zancanaro C; Verona
18. **Olfactometry using time-frequency analysis:** Stefanie Weise, Valentin A. Schriever, Thomas Hummel; Dresden
19. **Potential of spices as tools to study human olfaction and eating behavior:** Antti Knaapila, Laura Merinen, Oskar Laaksonen, Mari Sandell, Turku

Taste

20. **Gustatory Stimulation During Sleep and its Impact on Sleep Microstructure:** Moutsis TT, Sommer JU, Stuck BA; Mannheim
21. **Gustatory ERPs of the 5 basic taste qualities in humans and their brain sources:** Broy F, Hummel C, Hummel T, Iannill E; Dresden

Mixed bag

22. **Effects of analgesics on the intranasal trigeminal system:** Lars Mizera, Gudrun Gossrau, Thomas Hummel, Antje Hähner; Dresden
23. **Predictors of olfactory dysfunction in chronic rhinosinusitis:** Masayuki Harita, Kentaro Yamada, Takuya Noda, Kanako Teraguchi, Hideaki Shiga, Takaki Miwa. Kanazawa
24. **Multidimensional approach to the study of olfactory fear conditioning in individuals with low and high trait anxiety vulnerability**: Valentina Parma, Marc Coutanche, Janina Seubert, Robin Fondberg, Laura Hackl, Fredrik Åhs, Johan N. Lundström. Philadelphia, New Haven, Stockholm

Abstracts[1]

Short-term effect of caffeine on olfactory function

[1*]Albinus J, [1,2*]Meusel T, [3]Welge-Luessen A, [1]Hähner A, and [1]Hummel T.

[1]Smell and Taste Clinic, Department of Otorhinolaryngology, TU Dresden, Dresden, Germany; [2]Department of Otorhinolaryngology, Head and Neck Surgery, University of Erlangen Medical School, Erlangen, Germany; [3] Department of Otorhinolaryngology, Head and Neck Surgery, University of Basel, Basel, Switzerland; *contributed equally; janine.albinus@web.de

Introduction: The purpose of this study was to investigate the potential effects of caffeine in patients with olfactory loss. The suggested mechanisms of action consist in the non-selective blocking of adenosine receptors as well as in phosphodiesterase inhibition.

Materials and Methods: Olfactory function was tested twice in 76 patients with olfactory loss. The participants were divided into two groups: one received espresso with caffeine (65 mg/cup), the other espresso without caffeine (placebo). Before and 30 minutes after espresso consumption olfactory function was assessed for phenyl ethyl alcohol odor threshold, and odor discrimination.

Results: Across all participants, in comparison to placebo there was no significant effect of caffeine on olfactory function, regardless whether the cause of the olfactory loss was an acute infection of the upper respiratory tract or sinunasal disease.

Conclusions: These results indicate that the phosphodiesterase-inhibitor/adenosine-receptor agonist caffeine has little or no short-term effect on olfactory function in patients with olfactory loss.

Olfactory spaces: relating chemical and perceptual spaces to neural activity

Bensafi M

Centre de Recherche en Neurosciences de Lyon, CNRS, INSERM, Université Claude Bernard Lyon 1, France; moustafa.bensafi@cnrs.fr

An important issue in olfaction research is to relate brain activity to physico-chemistry of stimuli and perception. We present here a brain imaging study aimed at relating neural activity in human olfactory cortex and chemical space of odorants on the one hand and perceptual space of odors on the other hand. By combining Multi-Voxel Pattern Analysis and fMRI, we found distinct spatial activity patterns in piriform cortex (PC) as a function of chemical and perceptual similarity: whereas anterior PC activity significantly correlated with similarity in odorant physicochemical features, posterior PC activity significantly correlated with olfactory perceptual similarity (i.e. odor intensity, familiarity, pleasantness and edibility). Such effects were not observed in human amygdala. Rather, spatial activity of this area was significantly correlated with trigeminal perceptual similarity (i.e. irritation, coolness, warmth and pain). Combined with previous works, these findings strengthen the notion of segregated neural representations for chemical space and perceptual space of odors.

[1] Abstracts were not mandatory

Olfactory event-related potentials in children and adolescents

Carolin Boerner[1], Thomas Hummel[1], Eri Mori[3], *Valentin Alexander Schriever*[1,2]

[1]*Smell & Taste Clinic Department of Otorhinolaryngology,* [2]*Department of Neuropediatrics, University Hospital Carl Gustav Carus, TU Dresden, Germany;* [3]*Department of Otorhinolaryngology, Jikei University, School of Medicine, Tokyo, Japan;* caro.boerner@gmx.de

Gustatory ERPs (gERPs) of the 5 basic taste qualities in humans and their brain sources

Broy F, Hummel C, Hummel T, Iannill Ei

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Gustatory event related potentials (gERPs) can be used to investigate human taste function in a more objective way than psychophysical tests. One of the first who demonstrate this possibility was Kobal (1985). Recently, also other groups succeeded in the assessment of gERP (Hummel et al., 2010. Mizoguchi et al., 2002). However a standardized approach is still missing. Nowadays a new generation of taste stimulators (Gustometer, GU002/GM05, Burghart, Wedel, Germany) has been made available; it is specifically designed to elicit gERPs (Singh et al., 2011). For this reason in this work we aimed to characterize gERPs in response to the five basic taste qualities, using the gustometer for stimulus presentation. We intended to produce a standard protocol to be applied either in experimental research or in the diagnosis of gustatory dysfunction.

Thirty healthy, young volunteers attended the study (mean age: 23 years, s.d.=2 years). The experiment was subdivided in two sessions: (a) psychophysical intensity evaluation of the taste presented with the gustometer and (b) recording of the gustatory event related potentials (gERPs) using a 128-channel EEG system (BioSemi, Amsterdam, NL) .

The experiment provided (a) five calibration curves with stimulus concentration plotted against perceived intensity. From these curves the concentration corresponding to a medium intensity was chosen for the recording of gERPs (b). Following extensive pre-processing we analyzed the responses to all five tastants. We found that human gustatory processing can be described by 4 basic electrical maps, that we can code as 1, 2, 3, and 4. Independently from the tastant the process starts with map 1 and is followed by map 2. Source analyses for each map yielded primary (frontal operculum / insula) and secondary (prefrontal cortex) gustatory regions (Small et al. 1997; Schoenfeld et al. 2004; Hummel et al. 2007; Iannilli et al. 2012).

After 370 ms, processing becomes taste dependent. Map 4 and 5 are found alternating among the different taste conditions. Interestingly, source analyses at this stage highlighted areas in the left or right inferior frontal gyrus, covering the parietal operculum and middle/posterior insula which is in agreement with the posterior shift of brain activity found by Iannilli et al. (2014).

References: Kobal G (1997) Gustatory evoked potentials in man. Electroencephalogr Clin Neurophysiol; Hummel C, Frasnelli J, Gerber J, Hummel T. (2007) Cerebral processing of gustatory stimuli in patients with taste loss. Behav Brain Res. Iannilli E, Noennig N, Hummel T, Schoenfeld AM. (2014) Spatio-temporal correlates of taste processing in the human primary gustatory cortex. Neuroscience. Iannilli E, Singh PB, Schuster B, Gerber J, Hummel T. (2012) Taste laterality studied by means of umami and salt stimuli: an fMRI study. Neuroimage. Schoenfeld, M.A., Neuer, G., Tempelmann, C., Schussler, K., Noesselt, T., Hopf, J.M., Heinze, H.J. (2004). Functional magnetic resonance tomography correlates of taste perception in the human primary taste cortex. Neuroscience; Small, D.M., Jones-Gotman, M., Zatorre, R.J., Petrides, M., Evans, A.C. (1997) A role for the right anterior temporal lobe in taste quality recognition. J. Neurosci.

Balsamic, indulgent and well-being inducing smells – in search of chemical and physiological traces

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The search for smells that positively impact humans is not only a contemporary trend but also a voyage of rediscovering what ancient societies already knew… hops, lavender, frankincense, oriental infusions; these are just a few of the plants and materials that impact our body and mind through their characteristic and unique smells.
Decoding the chemical composition and the physiological impact of such smells, however, can be an extremely challenging task. The lecture aims at providing insights into modern approaches in the attempt to understand these fascinating processes, but also the main problems when trying to grasp the impact of such historic smells on human beings.

Binaral olfaction sharpens sense of smell

Denise **Chen** and Jin Wang
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Most sensory inputs are bilaterally distributed, which facilitates the task of localizing objects in space. Examples include binocular cues that provide depth information and binaural cues for sound location. Most of these effects have been extensively studied both in humans and other animals, but the role of binaral olfaction in humans remains to be clarified. Here we address this issue using triangular-forced-choice tasks, comparing detection accuracy in the binaral (different smells to each nostril) and mononaral (same smell to the nostrils) conditions. We focus on the effect of an undetectable smell, finding that it remains undetectable in the mononaral condition, but becomes detectable in the binaral condition. Our findings demonstrate that, in parallel to vision and audition, binaral olfaction enhances object detection in humans. In addition to shedding new light on the workings of bilaterally distributed sensory processing, our work also provides new evidence that humans are capable of discriminating an inexhaustible number of smells, in spite of the conventional wisdom that human olfaction is a feebly developed evolutionary vestige.

Reduced olfactory threshold, identification and discrimination in the Down syndrome

Maria Paola **Cecchini**[1], Marco Sandri[1], Dario Viviani[2], Thomas Hummel[3], Carlo Zancanaro[1]
[1]Department of Neurological and Movement Sciences, Anatomy and Histology Section, University of Verona, Verona, Italy; [2]U.O. Pediatria, Ospedale Sacro Cuore Don Calabria, Negrar, Italy; [3]Smell & Taste Clinic, Department of Otorhinolaryngology, University of Dresden Medical School, Dresden, Germany; mariapaola.cecchini@univr.it

Down syndrome (DS) shows Alzheimer-like neuropathological findings and clinical features of deterioration similar to those typical of Alzheimer disease. DS subjects over the age of forty years show senile plaques and neurofibrillary tangles in the brain. It is well known that Alzheimer disease is characterized by olfactory impairment. Accordingly, it may be hypothesized that olfactory impairment is also present in DS. Actually, clinical findings of difficulty in smell performance have been shown in DS since decades; however, nasal health has been found to be comparable in DS and healthy subjects, supporting the idea that olfactory deficits are secondary to central, rather than rhinologic, pathology. In the last thirty years, some works investigated olfactory function in DS employing variable numbers of

subject of different ages, and using different methods. These studies mainly assessed odour threshold or identification, or olfactory memory. Only one study considered olfactory discrimination performance. While all studies reported some olfactory impairment in DS subjects, a comprehensive evaluation of olfactory function in the DS is still lacking.
In this work, we assessed olfactory function in male (M) and female (F) DS subjects (n=56; M=31, F=25) over a wide range of age (18-57 years) in comparison with euploid healthy control (HC) subjects (n=53; M=23, F=30, age range: 18-61). To the best of our knowledge, this is the second largest group of Down subjects investigated for olfactory function ever.
We used a standardized test (Sniffin' Sticks Extended test, Burghart Company, Germany) to measure olfactory threshold, discrimination, and identification performance; results of the three subtests are presented as a composite global score defined as "TDI score". This procedure has been validated on more than 3000 subjects and it is widely used in Europe but, to our knowledge, never applied in DS subjects. Data were analyzed using one-way ANOVA and the Pearson (r) correlation coefficient.
Results showed that the two groups (DS, HC) were not different for age ($F=0.732$, $p=0.394$) and sex ($F=1.552$, $p=0.216$). All DS subjects reported to have normal smell. When olfactory performance was compared in the two groups, the DS subjects showed consistently lower values for the total score (TDI): 16.73±5.127 vs 35.42±3.745; $F=422.486$, $p<0.001$. Within the DS group, comparison of young-adult (18-29yrs, n=34) and older (30-57yrs, n=22) individuals showed that mean TDI score was higher in young-adults (17.43±5.155 vs. 15.65±5.005), but the difference was not significant ($F=1.640$, $p=0.206$).
The results obtained so far show that olfactory function is overall impaired in DS subjects.
This work was supported by grants from the "Fondation Jérome Lejeune", Paris, France and PRIN 2010-2011 funds to CZ.

Flavor-nutrient conditioning is altered in overweight individuals

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Flavor preferences are thought to be dependent upon associative learning. One critical associative process is flavor-nutrient conditioning (FNC) whereby preference increases for a flavor paired with positive post-ingestive consequences, i.e. the ingestion of nutrients (Holman,1968; Sclafani, 2004). This form of learning depends critically on dopamine signaling (Sclafani. 2011). Since dopamine signaling is blunted in obesity, we predicted that FNC would be impaired in overweight individuals.
17 healthy weight (HW) and 15 overweight (OW) participants were enrolled in an FNC paradigm. Fasted participants first rated their liking for novel flavored beverages during a pretest. Then, over a three week-long conditioning protocol, they ingested one of the flavored beverages with 112.5 kcal from maltodextrin (CS+), a tasteless and odorless polysaccharide, and another flavored beverage with no calories added (CS-). Pairing 112.5 kcal with a flavor is known to increase liking for that flavor as determined from previous testing in HW, based on doses ranging from 0 to 150 kcal. Following the conditioning phase, liking of the non-caloric versions of the beverages were reassessed at post-test. For each participant, flavor-calorie pairings were held constant but the identity of the conditioned flavors were counterbalanced across participants.

All participants rated all flavors as slightly liked at pre-test. Liking ratings increased significantly to “like moderately” for the CS+, but not CS- flavor in the HW group following exposure. In striking contrast and as predicted, liking ratings for the CS+ and the CS- flavor did not change in the OW group after exposure. These results demonstrate that flavor preference formation is disrupted in OW individuals.

Specific anosmia as a principal of olfactory perception

Ilona Croy[1,2], Selda Olgun[1], Laura Mueller[1], Anna Schmidt[1], Marcus Muench[1], Guenter Gisselmann[3], Hanns Hatt[3], Thomas Hummel[1]

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Specific ansomia, also known as partial anosmia or odor blindness, is a phenomenon referring to the inability to perceive a specific odor while detection of other substances is unaffected. It is known as a rather rare phenomenon, potentially caused by a lack of specific receptors. We tested the ability to perceive 20 different odors in a total of 1800 normosmic persons. Specific anosmia was found in 0 to 20.4% of the participants, depending on odor. Substances with higher molecular size had a significantly higher rate of specific anosmia ($r=0.495$, $p=0.023$). Most of persons exhibited anosmia to one but no more odors. From the data on 20 odors, the probablitily of specific to more substances could be estimated. At about 100 odors, the probability that a person exhibits a specific anosmia to any of the substances approaches 1. The results could be confirmed in a retest with 200 persons, not investigated previously. 30 Persons with specific anosmia received three months of olfactory training for the odor. This training improved perception of the odor in all participants ($p<0.001$) in a way that none of them was within the range of specific anosmia.We propose specific anosmia being a rule, not an exception of olfactory perception. The lack of perception of certain substances could be a flexible peripheral filter mechanism. This peripheral filter can be adapted by exposure.

Olfaction in Dementia with Lewy Body and in Parkinson Dementia: Discrimination by sensitivity

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OBJECTIVES: Dementia with Lewy bodies (DLB) is a neurodegenerative disease sharing clinical and neuropathological characteristics with both Parkinson's disease (PD) and Alzheimer's disease (AD). The features of DLB and Parkinson disease dementia (PDD) are difficult to dissociate clinically [Tröster, 2008]. This study aimed to assess olfactory and trigeminal function in patients with DLB and PDD in comparison to healthy controls, and to determine whether odor detection thresholds could contribute to differentiate DLB from PDD.

METHODS: All subjects included were over 65 years old (mean age 83.3 ± 7 years). DLB and PDD were diagnosed by experienced geriatricians and neurologists according to the revised consensus diagnostic criteria of both syndromes [McKeith et al., 2005; Tröster, 2008].

Odor detection thresholds of patients with DLB [mean age 85± 6 years, range: 65-93 years], patients with PDD [mean age 78 ± 6 years, range: 70-90 years] and controls [mean age 86 ± 7 years, range: 69-97 years], (n=20/group; matched for age and gender) were assessed.
To test olfactory sensitivity, we used Phenyl Ethyl Alcohol (PEA) [as a CN I stimulant], n-Butanol (BUT) [as a stimulant of both CN I and V] and Pyridine (PYR) [as a predominant stimulant of CN V and eventually conditionally CN I]. Dilutions series were made by factor-2 dilutions in distilled water. Dilution series for Odor detection thresholds ranged from dilution-step 0 to 20 for BUT, from 0 to 23 for PEA and from 0 to 26 for PYR. To minimize adaptation, olfaction testing followed an ascending stair-case procedure, with approximately 90 sec. between-trial intervals.
RESULTS: Patients afflicted with DLB had significantly lower detection thresholds for the 3 odorants than patients with PDD, who themselves had lower thresholds than the healthy controls.
CONCLUSION: Both DLB and PD are characterized by olfactory deficits and are often misdiagnosed, which leads to confound them. The present study shows a clear difference in odor detection thresholds in DLB, PPD and controls, the most impaired being the DLB. Olfactory detection threshold could be clinically useful in identifying DLB patients and severe olfactory detection impairment could be considered as a new diagnostic criterion for DLB.
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Targeting the brain through the nose: effects of an intranasal insulin application on human olfactory perception and memory processes

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The hormone insulin is considered an important metabolic key signal between the endocrine system and the brain, especially during the regulation of food consumption. Cerebral insulin receptors in the hippocampus and hypothalamus, but also in the olfactory bulb are responsible for the effects of an increased cerebrospinal insulin level. We hypothesize that the anorexigenic effects of the neuropeptide insulin are mediated by a modulation of the processing of olfactory signals on a peripheral or central level. With this set of studies we aim to examine the effects of an increased cerebrospinal insulin level on olfactory perception and memory processes. In order to deliver insulin and placebo to the brain the non-invasive method of intranasal insulin application will be utilized. Within a behavioral study we were able to show that intranasally applied insulin in comparison to placebo leads to a decrease in olfactory sensitivity for the odorant n-butanol. Further, we demonstrated that olfactory memory processes are enhanced by an increased insulin level in the cerebrospinal fluid.
Our results provide innovative insights into the interaction of cerebrospinal insulin with the olfactory system. Conclusions on the fundamental mechanisms of insulin effects on food consumption and the mediation of satiety in healthy subjects can be drawn. Our results provide background information for the development of novel therapy strategies for diseases of which it is well-established that cerebrospinal insulin levels are reduced (Morbus Alzheimer) or an insulin resistance exists (overweight, adiposity).

The effect of acupuncture on olfactory function in patients with post-infectious smell loss

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The possibilities of therapy for patients with post-infectious olfactory dysfunction are restricted. Based on a study by Hauswald et al. 1998 we tested the effect of acupuncture on olfactory function in patients with post-infectious olfactory dysfunction in a randomized, single-blinded, placebo-controlled study. Sixty patients with post-infectious olfactory dysfunction were included and were randomly assigned to two groups (verum- and placebo-acupuncture). Every patient received 12 acupuncture treatments. Before and after treatment a sniffin' sticks-test was performed.
At baseline, patients did not differ in terms of olfactory function, age, and duration of the disease. After acupunctur, within the groups a significant improvement of the TDI-score (comprehensive score of odor threshold, discrimination, and identification) was found in the verum-group, which was not seen in the placebo groupBetween the verum and the placebo group TDI score differences and discrimination score differences turned out to be significant. Correlational analyses between the duration of the disease and the TDI-difference proved to be significant; no correlation was found between age, baseline TDI score and TDI score difference.
Our data indicate, that acupuncture might be an alternative therapy for patients with post-infectious olfactory dysfunction. Best results were achieved with a short duration of disease. Older people as well as anosmics can benefit from this treatment.

The role of taste and smell in the regulation of food intake in healthy individuals and in individuals with taste and/or smell disorders

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The sense of taste and smell have an important role in the regulation of food intake. Taste and smell make up a large part of the reward value of food. Although taste and smell are intimately related to each other their role in food intake is different. The taste system detects macronutrients in food (sweet, carbohydrates; umami, protein; fat, fat; salt, fluid balance; bitter and sour, danger). The oral exposure to taste is a strong determinant of meal size. Ambient odors seem to act as a primer to elicit sensory specific appetites. These functions may be disturbed with impairments in the sense of taste and smell.

Does Sjogren's syndrome affect odor identification abilities?

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Sjogren's syndrome is an autoimmune disease that affects multiple systems. One of the complaints of Sjogren's syndrome is the loss in ability to smell. By measuring the smell identification ability in Sjogren's syndrome, we find that 40% of Sjogren's syndrome patient score below normative value suggesting that smell is affected in Sjogren's syndrome.

Olfactory function in Aspirin tolerant and intolerant patient with chronic rhinosinusitis- a prospective study

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Aim of the present study was to compare olfactory function in Aspirin tolerant and intolerant patients. To that end 31 patients with chronic rhinosinusitis that were referred to Pulmonary Hospital of Coswig for oral Aspirin tolerance testing were included in the study. Aspirin tolerance testing revealed 15 tolerant and 16 intolerant patients. Olfaction, measured as tdi-score, was significantly (p=0.04) poorer in the intolerant group (19.16 ± 9.52) compared to the tolerant group (26.80 ± 10.25). Three month after Aspirin desensitization olfactory function was neither significantly different among the study groups nor was it significantly (p=0.14) different between the intolerant (20.66 ± 9.29) and tolerant (26.02 ± 10.44) group.

Due to the large overlap of olfactory test results it is not possible to predict Aspirin tolerance by means of the "Sniffin' Sticks" involving tests for odor threshold, odor discrimination and identification in patients with chronic rhinosinositis. Olfactory function does not significantly change within 3 month after Aspirin tolerance testing.

Olfactory training in Parkinson´s disease

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Decrease of olfactory function in Parkinson's disease (PD) is a well-investigated fact whose impact on daily life is often underappreciated. Studies indicate that pharmacological treatment fails to restore olfactory function in PD patients. Olfactory training however, has been shown to improve olfactory function in humans. The aim of this randomized, single-blind, controlled investigation was whether patients with PD would benefit from ''training'' with high concentrations of odors in terms of an improvement of their general olfactory and cognitive function. Olfactory training was performed over a period of 12 weeks while patients exposed themselves twice daily to four odors (rose, eucalyptus, lemon, cloves). Investigations were performed at two visits with a detailed assessment of olfactory function. Further, considering the close association between olfactory and cognitive function brief cognitive tests were performed. Sixty subjects trained with either high or low concentrations of four odors. The same study protocol was applied to 100 age-matched healthy persons to compare the training effect with the general population. After 12 weeks of training the smell score differed significantly between the 2 groups of PD patients. The high concentration group improved significantly with the most pronounced change in identification ability. In the group of age-matched controls also a significant improvement of olfactory function was seen for hyposmic participants in the training group, and a tendency for improved cognitive function and subjective well-being. Therefore, it might be hypothesized that olfactory training has positive effects on cognitive processing of olfactory information which is partly reflected by the cognitive tests. The results indicate that the structured, short-term exposure to odors might be beneficial for PD patients.

Predictors of olfactory dysfunction in chronic rhinosinusitis.

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Abstract: Olfactory dysfunction is a major symptom of chronic rhinosinusitis (CRS). Although both medical and surgical treatment are provided for CRS, but some patients don't improved their olfactory function by these treatment. In this report, we investigate predictors of olfactory function of CRS patients.

Gustatory cortex and its dynamical processing

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Neuroimaging research on human gustatory perception has revealed a complex brain network involved in the sense of taste (Veldhuizen, Albrecht et al. 2011). Although primary gustatory cortex is coherently been found inside the insula from several works (Kobayakawa, Endo et al. 1996; Faurion, Cerf et al. 1999; de Araujo, Kringelbach et al. 2003; Iannilli, Singh et al. 2012), its location has been showed dynamically shifting from the anterior/middle insula to a posterior part of insular cortex (Iannilli, Noennig et al. 2014). Moreover the prefrontal cortex, also known as putative secondary gustatory cortex, is densely interconnected serving other sensory modality like olfactory, texture and temperature, that influence the sense of taste (de Araujo and Simon 2009; Seo, Iannilli et al. 2013; Iannilli, Bult et al. 2014). In summary the gustatory cortex appear to be a dynamic complex network mostly devoted to the integration of multisensory perception.

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Oral stimulation with water induces event-related potential in humans

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How the human brain processes the perception of water in the mouth is unclear. Some interesting research, using functional magnetic resonance imaging, EEG-derived event-

related potentials or magneto-encephalography shows that water acts as a tastant (de Araujo 2003, Hashida 2005, Murayama 1996) producing activations in cortical taste areas like frontal operculum/anterior insula and/or the caudal orbitofrontal cortex. In contrast, other studies claim the absence of a brain response to water (Kobajakawa 1996, Onoda 2005) but they suggest to use water as a tasteless solution for baseline.
In experiments that focus on gustatory perception the baseline (or the off condition) has a fundamental methodological significance. In this study we aimed to investigate the electrophysiological response of the human brain to water. To this end we used a computer-controlled gustometer which has been demonstrated to be able to elicit gustatory event-related potential (gERPs). The device is based on a pump system that allows to deliver quasi-rectangular gustatory stimuli. Four conditions were chosen: 1. Somatosensory, 2. Temperature, 3. Taste, 4.Water. The conditions were presented on the tip of the tongue in a controlled experimental environment. Although EEG was recorded in 128 positions, here we discuss only a 5-channel subset, Cz, Pz, Fz, C3 and C4.
As a result we found a clear cerebral response under all 5 conditions, including water. The statistical analysis on the ERPs component indicated a significant difference ($p<.001$) between the conditions among latencies, P_1, N_1 and P_{late}, and among the peak-to-peak amplitude, $A(P_1\text{-}N_1)$ and $A(N_1\text{-}P_{late})$. A multi-comparison test revealed that there was no significant differences at P1 and N1 latency and for the amplitude $A(N_1\text{-}P_{late})$ between the water and taste condition. These last results suggest a similarity in the human brain process of perception of taste and water.
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Potential of spices as tools to study human olfaction and eating behavior

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Background. As a pilot study of a project investigating role of odorous volatiles in food preferences, the aim of the study was to explore potential of spices as tools to study human olfaction related to eating.
Methods. We presented three sets of selected odorous samples orthonasally to 27 volunteers (17 women and 10 men; age 21–51 years, mean 31.6 years) for evaluation at a sensory laboratory: pure odorants (at 0.1–10%) dissolved in propylene glycol or water (18 samples), spice extracts (5), and (dried) spices (14, not visually masked). The participants rated the odors of all samples for the perceived intensity (on a scale 0–5), pleasantness (-4–4), and suitability to bread (no/maybe/yes). Spice extracts and spices were, in addition, rated for familiarity (0–4) and identified (multiple choice with 5 options).
Results. Among the spices, cinnamon, caraway, and cardamom were identified correctly by 100% of the participants, whereas the identification ratio was lowest for sage (19%),

coriander (30%), and tarragon (30%). The spice identification score was 6–14 (mean 10.2). Odors of cinnamon, cardamom, and aniseed were rated as the most pleasant. The most familiar odors were those of cardamom, cinnamon, and garlic. Odor of tarragon, on the contrary, was rated as both the least pleasant and least familiar. Consistently, the spice-specific means of the familiarity ratings correlated strongly with the respective pleasantness ratings ($r = 0.67$; $p < 0.001$) and with the number of correctly identified spice samples ($r = 0.53$; $p = 0.004$). The odors of garlic (and allyl disulfide), caraway (and (+)-carvone), oregano, thyme, and rosemary were regarded as the most suitable for bread (more "yes" than "no" responses), while tarragon and mint (and menthol) were the least suitable (<2 "yes" responses).

Conclusion. Individuals vary widely in how they respond to the odors of spices. Different spices were also experienced very differently. Spices provide versatile and useful selection of odor stimuli for research on individual differences in olfaction and food preferences.

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Influence of HLA correspondence in partnership and sexuality

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Aim of the study was to investigate the relation between HLA type and partnership and sexuality. Several aspects of partnership were considered, depending on the correspondance of the couples in HLA class I (A, B, C) and class II (DP, DR, DQ) alleles. We could show that couples with matching HLA class I alleles (B,C) rate their partners odor, their sexuality and their partnership significantly worse compared to couples with non-matching HLA B and C alleles. Consequently, non-matching couples had a stronger desire to have children than matching couples. Furthermore men who were heterozygous for HLA-A were evaluated better by their partners than homozygous ones. In contrast, we did not find evidence that class II HLA alleles influence partnership. Overall, the current study supports and extends previous work showing that HLA groups are of significance in partnership and sexuality.

Ageing effect on gustatory function: a high density channels event-related potentials study

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Gustatory event related potentials (gERP) were first established by Funakoshi und Kawamura in 1971. In 1985 Kobal developed a device able to elicit gERPs which was in modified versions also applied by other groups (Hummel et al., 2010. Mizoguchi et al. 2002).

Aim of the present study was to use psychophysics and gERPs to investigate age-related differences in the processing of gustatory information as indicated by the cerebral sources of the gERP. A total of 96 subjects participated in the study. After olfactory and gustatory screening for normal function the volunteers were invited to two sessions of gERP acquisition. Subjects received a randomized combination of five iso-intense basic tastants presented at a medium-level . To record gERPs a 128-channel EEG system (BioSemi,

Amsterdam, NL) was used. The whole group of participants was subdivided in four age sub-groups.
Psychophysical testing for smell and taste function included the “Sniffin’ Sticks” (Hummel et al. 2007; Kobal et al. 1996) and the “Taste Strips” (Landis et al. 2009; Mueller et al. 2003). Both, olfactory and gustatory function exhibited a significant decrease with age. Currently analyses are underway to investigate age-related changes in electrical brain activity and their sources. 4 Stable topographical maps describe the gustatory process among the five basic taste conditions and the 4 different groups. The short presence of Map 5 for elderly people suggest that the cerebellum, found to be a main source of the map, may play an important role in the reduction of olfactory and gustatory functions at that stage, similarly to what has been found for intellectual capacity in healthy aged population (Lee et al. 2005).
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Olfactory memory is separate from other forms of memory in the old and very old: Evidence from a population-based study
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Drug effects on human olfaction
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Rapid and context-dependent plasticity of human olfactory functions
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aversive conditioning augments our discriminatory abilities, making us better able to discriminate between relevant and non-relevant signals. It has been long been hypothesized that this originates from a cognitive modification of the sensory stimulusâ€™ quality. In this talk, I will outline results from an ongoing project where we pursued the alternative hypotheses; that aversive conditioning of a stimulus would increase the detectability (sensitivity) of that specific stimulus, thus demonstrating sensory rather cognitive based augmentation. Together, our results obtained using both behavioral and neuroimaging methods indicate that increasing the biological salience of an olfactory stimulus gives it priority to sensory processing, which in turn augment sensory acuity in an odor-specific manner.

Expecting women keeping cool: Pregnancy prevents the chemosensory transmission of anxiety
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Research has shown that humans effectively communicate anxiety via chemosensory signals. As pregnant women show diminished responses to stress signals, the current study aimed to

investigate how pregnancy affects the neuronal response to human chemosensory anxiety signals.
Using cotton pads, axillary sweat was collected from 28 men while waiting for an important oral examination (anxiety condition), and during ergometer training (control condition). Using a constant-flow olfactometer, odor samples were presented to 12 non-pregnant women, 14 women in their first and 18 in their third trimester of pregnancy in an oddball paradigm. EEG was recorded from 60 scalp locations, and chemosensory event-related potentials in response to deviant stimuli were analyzed.
In general, both women in their 1st ($p = .04$) and women in their 3rd ($p = .01$) trimester of pregnancy showed smaller P3-amplitudes than non-pregnant women. Moreover, only non-pregnant showed larger P3-amplitudes ($p = 0.01$) and shorter P3-latencies ($p = .002$) in response to anxiety compared to control sweat. In response to anxiety sweat, both women in their 1st ($p = .05$) and women in their 3rd ($p = .001$) trimester of pregnancy showed longer P3-latencies than non-pregnant women.
Results show both delayed and reduced processing of chemosensory anxiety signals during pregnancy, suggesting an attenuated chemosensory transmission of anxiety. This reduced central nervous responsiveness might reflect the earliest component of a stress protection mechanism during pregnancy, possibly mediated by hormonal factors.

Men and Women React Differently to Room Fragrances

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With a special focus on potential benefits of widely used room scents the aim of the present blinded study was to investigate attention, anxiety, and mood in a large group of healthy people during exposure to various pleasant odors compared to the same situation in a non-odorous environment. A psychological test battery (d2 test of attention, State-Trait-Anxiety-Inventory, Beck Depression Inventory, Multidimensional Mood State Questionnaire) was applied to 200 normosmic subjects, placed in rooms with 4 different room fragrance conditions (rose odor; grapefruit odor; combination of orange, lime, and lemon odor; odorless control). Following exposure subjects were asked to rate occurrence and severity of heart problems (tachycardia/palpitations), headaches or breathing problems.
Results revealed an overall positive effect of room fragrance on attention, anxiety, and mood. Especially grapefruit fragrance was associated with a significant reduction of trait anxiety. Exposure to odors seemed to differentially affect men and women with men presenting unfavorable results in rose fragranced rooms whereas they seemed positively affected by grapefruit smell. Exposure to the fragrances was not associated with a higher incidence of physical symptoms. These results indicate that grapefruit odor may be a more suitable room fragrance for mixed-gender groups than rose odor in order to reduce anxiety and to improve attention, and mood.

What is musk?

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Changes in Smell and Taste Function in the Elderly.

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Abstract: It is known that both smell and taste functions decrease with aging. However, some clinical questions remain, such as the independence of each sensation loss and the correlation between a person's actual sensory loss and awareness of the loss. In this research, we investigated both the olfactory and taste functions of aged subjects together with their awareness of sensation loss.

Effects of analgesics on the intranasal trigeminal system

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Analgesics are known to affect the trigeminal nerve especially in neuralgias. Intranasally, the olfactory and trigeminal system interact with each other in many ways. It has been shown that drugs interfere with the nasal chemosensory system, but the effects on the trigeminal system are poorly investigated. The aim of this study was to investigate the influence of non-opioid drugs and weak or strong opioids on the intranasal olfactory and trigeminal system. One hundred patients suffering from chronic pain with a long- term use of analgesics were assigned to three groups depending on their treatment based on the World Health Organizations' guidelines for pain relief. A control group consisted of 95 persons without chronic use of analgesics. Olfactory function was tested using the 'Sniffin' Sticks' – a comprehensive method including test for odor threshold, discrimination and identification. For trigeminal stimulation, four odors (isoamyl acetate, cineole, eucalyptus and peppermint) were presented alternately in sniff bottles to the participants who rated their intensity using a visual analogue scale. Olfactory function was not found to be different between the three groups. However, odor discrimination and odor identification were found significantly reduced when compared to the control group. Trigeminal function in pain patients also differed significantly compared to controls. Intensities of the stimuli were rated significantly lower than in controls. Lowest results were seen in patients with non-opioid drugs. In this study, we have shown evidence that the intranasal trigeminal system may be influenced by analgesic drugs.

"Kaiteki" position to reach the olfactory cleft for the nasal drops

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Background: Treatment of sinunasal olfactory dysfunction is problematic. While systemic treatment with corticoids shows therapeutic effects, few patients benefit from intranasal topical drug application. This may partly be due to access of the intranasal spray to the

olfactory epithelium. Aim of the present study was to investigate how nasally applied substances distribute within the nose depending on the form of application.
Material and Methods: A total of 13 healthy volunteers participated. The tilted head position was named as "Kaiteki" method, lying on the side. Blue food dye was used to visualize the intranasal distribution of the liquid. The investigation was carried out using nasal endoscopy; the intranasal distribution of the dye was judged by three independent observers.
Results: Nasal drops reached the nasal floor in 12 cases (92%). In addition, the blue dye was widely distributed in the nasal mucosa.
Conclusions: The present data suggest that previous failure of therapy with locally applied drugs in case of sinunasal smell disorders may be partly due to the fact that the drugs did not reach the olfactory cleft when using traditional forms of applicators and positioning. However, using the Kaiteki method lying sidewise it seems likely to present the drugs more effectively and comfortably to the olfactory epithelium. Thus, it may be hypothesized that therapy could be more effective using the Kaiteki method.

Gustatory Stimulation During Sleep and its Impact on Sleep Microstructure.
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Gustatory Function in Patients with Chronic Rhinosinusitis
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Objectives: Assessment of gustatory sensitivity using the 'taste strips' test is a validated procedure. Recent research showed that taste receptors in airway epithelial cells are involved in the defense of upper respiratory tract infection. The aim of the study was to investigate gustatory function in patients with chronic rhinosinusitis (CRS).
Methods: The investigation included 27 patients (20m, 7f, mean age 41, range 20 to 82 years) with CRS. The extended 'taste strips' test with six concentrations of sweet, sour, salty, and bitter taste was performed in these patients.
Results: The mean (± SD) extended taste score was 10.7±2.78. Results for each taste quality were: 3.85±1.23 for sweet, 2.62±1.04 for sour, 3.99±1.33 for salty and 3.11±1.16 for bitter taste. Compared to normative values a significantly decreased extended taste score (p=0.002) and decreased sensitivity of sweet (p=0.012) and bitter (p=0.007) taste could be observed.
Conclusions: Patients with CRS show significantly decreased gustatory function compared to healthy controls. Local defense mechanisms within the sinunasal epithelium might be linked to gustation in a clinically relevant way. Assessment of gustatory function seems to be useful in patients with recurrent upper respiratory tract infections.

The Sense of Smell in Old Age - Preliminary Results

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The aim of the study was to find out whether in a Czech population of the elderly over 60 years of age olfactory decline is associated with lower self-assessed quality of life and selected demographic variables, particularly age and education, and cognitive functions. 87 individuals (56 women), mean age (SD) 76.33 +- 8.02 (range 61 - 93) years participated in the study so far. The olfactory abilities of odor identification and discrimination were tested with the Sniffin' Sticks test. Questions regarding self-assessed olfactory and gustatory sensitivity, phantosmia, parosmia, parageusia, heightened olfactory irritability, dietary habits and household accidents were administered. Cognitive abilities were assessed with the Mini Mental State Examination (MMSE) and Montreal Cognitive Assessment (MoCA) tests. Identification was positively correlated with education and MMSE and MoCA scores, Kendall's Tau-b = .23 - .29, $p < .01$, and negatively with age, Kendall's Tau-b = -.24, $p < .01$. Discrimination was only positively linked to MoCA scores, Kendall's Tau-b = .26, $p < .01$. In everyday life, individuals who reported olfactory and gustatory dysfunction were more frequently worried about their body odor, Kendall's Tau-b = .22, $p < .01$. Individuals exhibiting lower identification scores reported more frequent household accidents, Kendall's Tau-b = -.25, $p < .01$. These preliminary results show that in the elderly over 60 years of age sex differences seem to attenuate and, in line with previous studies, indicate a significant association between olfactory and cognitive functions. Also, they suggest a link between psychophysically tested olfactory decline and self-assessed quality of life.

Sequential context effects on odor pleasantness rating

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When we sequentially evaluate a character of sensory modality stimuli, evaluation of the stimuli is influenced by what precedes them; sequential effects (e.g., Holland and Lockhead, 1968). Hedonic contrast, is one of these phenomenon, stimuli are rated worse if they are preceded by the more pleasant stimuli (negative contrast), whereas stimuli are rated better if they are preceded by less pleasant stimuli (positive contrast) (Cogan et al., 2013). In this study, we investigated the hedonic contrast in olfaction comparing with visual sense. The results from a series of experiences indicated that both positive and negative contrast occurred in vision, while only negative contrast was shown in olfaction (Exp.1, 2 unisensory modality). Furthermore, when positive pictures were preceded by negative odors (Exp.3 crosssensory modality), the pleasantness of pictures was not overestimated compared with the group only rated positive pictures. These findings suggest that preceding pleasant odors decrease pleasantness of following odors while unpleasant preceding odors did not increase pleasantness of following odors as well as pictures. This is probably because odors are hard to rate more pleasant on account of ecological significance for unpleasant odors. These may cause the non-occurrence of positive contrast in olfaction.

Dynamic coding of different tastes in the human brain

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In spite of decades of research, we know very little about the cortical dynamics during gustatory perception in humans. Only a marginal number of event-related potentials (ERP) studies has been conducted on taste so far owing to difficulties in stimulus control; the few results suggest differences in processing time for different tastes. Independently, differences in behavioral response times have been reported for different tastes. If the latency differences at the behavioral and neuronal levels are related remains unclear. We measured multi-channel

head-surface electroencephalographic (EEG) in human participants while they received liquid tastants inducing salty, sweet, sour, or bitter sensations. Participants were passively tasting in one study and responding as quickly as possible to the tastes in another study. Electrical neuroimaging analyses were performed to characterize the time course and spatial distribution of the electric field at the head-surface level and physical-mathematical inverse solution and head models served to estimate the underlying active neural sources. The ERP yielded latency differences between tastes that varied depending on whether participants tasted passively or performed a speeded taste detection task. Notably, responses to salty and sour were clearly faster than responses to sweet and bitter. In the speeded task, neuronal response latencies correlated with behavioral responses latencies. When accounting for the difference in response latencies, source analyses revealed similar, yet not identical, cortical activations of the insula and opercula, superior temporal gyrus, ventromedial orbitofrontal and cingulate cortex for all tastes. Together, the results suggest that a common cortical network is activated by different tastes in a dynamic manner and that these dynamics, furthermore, interacted with

participants‘ behavioral goals.

A designated odor-language integration system In the human brain

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Odors are surprisingly difficult to name, but the mechanism underlying this phenomenon is poorly understood. In experiments using event-related potentials (ERP) and functional magnetic resonance imaging (fMRI), we investigated the physiological basis of odor naming with a paradigm where olfactory and visual object cues were followed by target words that either matched or mismatched the cue. We hypothesized that word processing would not only be affected by its semantic congruency with the preceding cue, but would also depend on the cue modality (olfactory or visual). Performance was slower and less precise when linking a word to its corresponding odor than to its picture. The ERP index of semantic incongruity (N400), reflected in the comparison of nonmatching vs. matching target words, was more constrained to posterior electrode sites and lasted longer on odor cue (vs. picture cue) trials. In parallel, fMRI cross-adaptation in the right orbitofrontal cortex (OFC) and the left anterior temporal lobe (ATL) was observed in response to words when preceded by matching olfactory cues, but not by matching visual cues. Time-series plots demonstrated

increased fMRI activity in OFC and ATL at the onset of the odor cue itself, followed by response habituation upon processing of a matching (vs. nonmatching) target word, suggesting that predictive perceptual representations in these regions are already established prior to delivery and deliberation of the target word. Together our findings underscore the modality-specific anatomy and physiology of object identification in the human brain.

Multidimensional approach to the study of olfactory fear conditioning in individuals with low and high trait anxiety vulnerability

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Introduction: Fear conditioning is a fundamental learning mechanism often used to model anxiety reactions across species. Threat-processing anomalies dependent on anxiety vulnerability have been mostly identified in cognition. However, recent evidence stresses the impact of anxiety on even the earlier stages of stimulus perception (sensory processing) and on the physiological and neurophysiological reactions. To experimentally test the effects of fear conditioning, most studies have used audio-visual material even though emotionally salient odors have been proven to produce stronger emotional reactions than visual stimuli, possibly in virtue of their direct access to amygdala and hippocampus. Here we aim to test, with a multidimensional approach, the impact of anxiety vulnerability on perception, physiological arousal, mean neural activations and activation patterns in an odor-based fear conditioning paradigm.

Methods: Twenty-one healthy participants were divided in two subgroups on the basis of their low (LAV) or high (HAV) trait anxiety vulnerability. Event-related perceptual ratings of odor intensity (visual analogous scales, VAS), psychophysiological arousal (skin conductance responses, SCR) and functional magnetic resonance imaging were co-registered within participants over a 20-min period in which odor-threat associations were repeatedly induced.

Results: Subjective odor intensity increased post-conditioning for both groups, suggesting experience-dependent sensory evaluation processing. Skin conductance responses were heightened for the HAV as compared to the LAV group, favoring the appearance of differential learning (CS+ vs. CS-) post conditioning. Anxiety vulnerability selectively impacted neural processing in areas of the fear network such as amygdala, insula and cingulate cortex. Multivariate pattern analyses of fMRI activity reveal learning-dependent effects on odor representations within both primary (piriform cortex) and secondary olfactory areas (orbitofrontal cortex) over time.

Conclusions: These results indicate that anxiety vulnerability differentially and dynamically modulates perceptual, physiological and neural responses to emotionally salient odors.

Taken together, these results contribute to the implication of sensory stimuli in the development and maintenance of anxiety disorders.

Configural and elemental abilities in adults with autism

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The processing of complex stimuli could be either done in an elemental or configural way. The elemental perception permits to separate all single elements of a complex stimulus but does not permit to understand the possible association between them. On the contrary, the configural perception permits to understand complex stimuli as a single concept but erase more or less the information of the single stimuli.

The weak central coherence theory suggests that individuals with autism have a tendency to perceive and process stimuli separately and focus on details while people with a normal development are able to integrate several stimuli and recognized them as a significant whole.

In our study we evaluated how the configural and elemental perceptions of odors differ from non-autistic subjects. Previous studies on vision or audition suggest that autistic subject would have lower configural/global abilities but better elemental/local capacities.

Twenty-five participants (mean age 38 ± 12.1) with autism (twenty-one with Asperger's Syndrome, four with high functioning autism) were compared to twenty-five well-matched controls (mean age 38.5 ± 11.7) with a normal development. In order to identify visual global/local processing abilities, all subjects performed Navon and Mosaic tests. In the "configural" study we used two odor mixtures known to blend (induce spontaneously a configural perception). One was a binary mixture which evokes the pineapple odor and the second one, composed of 6 components, evoke a grenadine syrup odor (Le Berre et al., 2008). None of the components evoke on its own the odor of pineapple or grenadine. Configural perception was measured by the level of pineapple and grenadine typicality and complexity of the mixtures as compared to the components. In the "elemental" study we used 6 odors previously used by Laing and Glemarec (1992). Elemental perception was evaluated by the number of correct identification in mixtures containing 2 to 6 odorants previously learned during two training sessions.

Autistic and Control subjects did not differ either in the configural or in the elemental odor mixture perceptions. Autistic subjects did not rate mixtures as being less typical of pineapple and grenadine as compared to controls. Both groups could not identify more than three odors in a mixture. However the autistic group also did not present better local and worse global abilities on Navon and Mosaic tests as compared to control group. Most of the studies in vision and audition were made with autistic children. Our autistic subjects were around 40 years old and it may suggest that they can compensate their global perception deficiency.

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My mind is elsewhere but my nose stays focused: effects of attention and emotion on olfactory perception.

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Odors are powerful emotion elicitors, given their significance and the saliency of their valence. It is known that affectively relevant stimuli can be processed outside of attentional focus. Nevertheless, olfactory emotions are plastic and can be altered by many cognitive or contextual factors affecting their perception. We therefore investigated whether neural responses to olfactory stimuli are affected by attentional manipulation, using a cross-modal audio-olfactory paradigm.
17 participants were presented simultaneously with odors and sounds. Odors were chosen beforehand according to individual preferences during a localizer task, in order to obtain pleasant, neutral, and unpleasant odor stimuli (6). All sounds were neutral (6). Participants had to perform a categorization task focusing on one or the other modality.
Neural activity in areas identified with the olfactory localizer (OFC: orbitofrontal cortex, amygdala, insula) was not enhanced when attention was directed to odors, contrary to primary auditory areas that were sensitive to the attentional manipulation. Areas associated with valence processing (OFC, insula, pallidum, middle cingulate and temporal pole) were modulated by odor type regardless of the modality of attention, and this effect was maintained in right insula and left OFC when the two attentional conditions were tested for valence effects separately.
These novel results emphasize the unique nature of olfactory stimuli and their emotional quality. The ability of odors to evoke strong affective responses at the brain level, regardless of explicit attention, could reflect some primitive alarm mechanism that detects and signals the presence of negative, potentially harmful smells, rendering them impervious to attentional modulation, in a comparable fashion to affectively relevant (eg: survival related) stimuli from other sensory modalities.

Laterality and onset of olfactory evoked magnetic fields in the human brain

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Humans are not able to localize whether a pure odorant was presented to the left or right nostril. This knowledge is also used in psychophysical testing to detect possible trigeminal co-stimulation when selecting pure odorants. On the neuronal level, there is limited information about the onset and laterality of olfactory processing within the primary

olfactory cortex. Recent imaging techniques show different advantages and disadvantages. The advantage of magnetoencephalography (MEG) is the high time resolution in combination with source localization. The objective of the current study was therefore to analyze the spatio-temporal patterns of primary cortical activity in response to left and right sided stimulation using MEG recordings.
In a set of 12 normosmic healthy subjects (six male and six female; age range 19 – 28 years) we investigated the onset of brain activities in relation to ipsi- and contralateral stimulation with two odorants (phenyl ethyl ethanol [PEA] and hydrogen sulfide [H_2S]). Olfactory stimuli (duration 200 ms; ISI 40 s) were applied using an olfactometer (OM4, Burghart Messtechnik) without causing concomitant stimulation of mechano- or thermoreceptors. Brain activity during odor perception was recorded with a 248-magnetometers whole-head MEG system (MAGNES® 3600 WH, 4-D Neuroimaging) confined in a magnetically shielded room.
Olfactory responses were identified shortly (within 150 ms) after stimulus onset in both hemispheres. Stimulation of the ipsilateral side provided earlier signals compared to contralateral stimulation in the primary olfactory cortex, hippocampal gyrus (HC), parahippocampus (PHC), amygdala, and orbitofrontal cortex ($P < 0.001$). In the HC and PHC, we observed gender differences with regard to higher amplitudes in female subjects (factor "gender" $p=0.016$ and $p=0.021$). Also within the HC region, a lateralization to the left hemisphere was visible indicating for left shifted olfactory processing in this brain region (interaction "hemisphere" by "stimulation side" $p=0.019$). In addition, the more unpleasant odor (H_2S) provided higher amplitudes in the entorhinal cortex compared to the more pleasant rose-like odor (PEA) indicating for potential hedonic encoding.
To our knowledge, this is the first study showing localizations of early olfactory brain activity in humans within 150 ms after stimulus onset. We observed that olfactory activation is processed ipsilaterally to the side of stimulation at early states. After a short delay of about 50 ms a corresponding pattern of activation was also visible in the contralateral hemisphere indicating for the functional connectivity between both hemispheres within the anterior commissure.

Exploring the chemical map in the olfactory bulb

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Most sensory areas in the brain exhibit a topological arrangement according to their stimulus space. Retinotopy in V1, tonotopy in the auditory cortex, and the "*homunculus*" in the somatosensory cortex are textbook examples for this observation. In our olfactory sense however, such an ordering has still to be demonstrated. The challenge in finding such a mapping is twofold: First, the chemical space of odorants is extremely complex, with no obvious mapping on a two-dimensional surface. Second, our knowledge on the chemical receptive fields of the several hundreds different olfactory receptor types is still scarce.
We approached this challenge by combining high-throughput *in-vivo* measurements of glomerular responses in the mouse olfactory bulb with chemical informatics and machine learning. We imaged the intrinsic optical response of the mouse dorsal olfactory bulb to 214 monomolecular odourants in 41 animals. A novel image segmentation algorithm based on non-negative matrix factorisation enabled us to automatically detect glomeruli by their functional response. Glomeruli were identified across individuals by matching their odour response profiles.

We found that the relative arrangement of glomeruli is conserved across individuals in a way that neighbouring glomeruli have overlapping response spectra. The large basis of measurements enabled us to build physico-chemical models of the receptive fields of the observed glomeruli. When we analysed the arrangement of glomeruli with respect to the similarity of their chemical receptive fields, we found a weak chemotopic ordering in the lateral-posterior domain of the dorsal olfactory bulb.
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Exposure to odors improves olfactory function in children

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Objective: Repetitive short-term exposure to odors, such as olfactory training, has been proven to have a positive effect on olfactory function, especially in people with olfactory disorders. This is possible because the olfactory system is one of the few regions where neurogenesis takes place, even in adults. Olfactory receptor neurons regenerate life long but decreases with aging. Therefore, aim of this study was to examine the effect of olfactory training in children and adolescents.
Materials/Methods: We compared odor identification abilities and odor thresholds between an olfactory training group (29 girls and 11 boys; mean age 11.5 years; TR group) and a group that did not perform such training (12 girls and 20 boys; mean age 11.7 years; noTR group). Participants exposed themselves to 4 odors over a period of approximately 12 weeks twice daily (“rose”, “eucalyptus”, “lemon”, “clove”). Olfactory testing was performed before and after the training period using the “Sniffin’ Sticks” test kit (odor identification plus odor thresholds).
Results: Before the training, the two groups did not differ in terms of age and olfactory function. After the training the TR group performed significantly better for odor thresholds for all 4 odors compared to the noTR group. Also, with regard to odor identification the TR group outperformed the noTR group.
Conclusion: Repeated short-term exposure seems to improve the olfactory function in children even with a normal sense of smell. This underlines the plasticity of the olfactory system.

Superadditive processing of food flavor is modulated by insular and entorhinal cortex connectivity

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Like music or art, food flavor is perceived holistically and elicits more powerful experiences than its individual parts; odor and taste, in isolation. This synthetic perception has been

shown to be influenced by learned associations between its individual components, which reinforce the object character and pleasantness of gustatory-olfactory stimuli relative to novel flavor combinations or food odors alone. The aim of the present functional magnetic resonance imaging study was to delineate the neural pathways by which the convergence of olfactory and gustatory pathways interfaces with acquired object knowledge to give rise these superadditive phenomena.
Healthy individuals (n = 32) were presented with a pleasant familiar beverage, orange juice, in three different conditions: naturalistic consumption of flavor (oral retronasal-gustatory presentation), taste only (oral presentation while maintaining a closed soft palate) and smell only (orthonasal presentation). Contrasting unisensory and combined olfactory-gustatory stimulation, we dissociated functional convergence in chemosensory processing networks from preferential processing of flavor, and determined connectivity patterns which were linked to the generation of a superadditive response to the combined olfactory-gustatory percept. Stimuli were presented in a pseudo-randomized event-related design by means of a computer-triggered olfactometer and gustometer, both of which allowed for stimulus delivery with high precision of duration and delivered quantities. For analysis, each chemosensory stimulus type was contrasted against a null event in the same modality (ambient air for odor, artificial saliva for taste and flavor) to model out any activation accounted for by swallowing, sniffing, or somatosensation.
Convergent, but subadditive activitation, to stimulation of the olfactory and gustatory pathways was observed in ventromedial orbitofrontal cortex, an area which has been commonly labelled as secondary olfactory cortex, as well as in structures implicated in reward and executive processing. Flavor, but not smell or taste of the stimulus alone, stimulated a large cluster peaking in the parietal and extending into the frontal operculum, supporting previous accounts of a central role for this area in flavor perception (Figure 1). Superadditivity was also observed in core areas of multisensory integration, including the superior temporal gyrus and intraparietal junction. Of interest, a functional dissociation was observed in the insula, where an anterior portion was characterized by a convergent activation pattern, while more posterior sections were characterized by exclusive activation to the flavor stimulus.
Psycho-physiological Interaction (PPI) analyses with the opercular flavor region demonstrated that activation to flavor stimuli was associated with increased exchange of information with the chemosensory convergence node in the anterior insula, as well as with the lateral entorhinal cortex; the latter which is thought to represent a core node for contextual modulation of cortical odor processing.
Taken together, these findings suggest a central role of the insular cortex in the formation of a superadditive response to convergent chemosensory input, and an important relay function of semantic memory circuits which may underlie the influence of emotion and learning on flavor perception.

Part of the pain matrix is thicker in patients with Burning Mouth Syndrom

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The BMS is an allodynia involving a more or less constant pain sensation in the mouth even without oral stimulation. This pain is so significant that it results in a permanent stress, increased by a reduced sleep quality which can turn into irritability, alterations of eating

habits and depression. The etiology and pathophysiology of Burning Mouth Syndrome (BMS) is not yet elucidated. We aimed here at determining whether BMS and dysgeusia (DYS), the most common taste disorder resulting in a distorted or an ongoing bad taste in the mouth, could result or induce cortical modification. Structural images (MRI 1.5 T) of 12 BMS subjects, 17 DYS and 13 controls (Ct) were included in a cortical thickness (CT) and voxel based morphometry (VBM) analyses. We identified that the posterior part of the supplementary motor area and the anterior part of the cingulate gyrus were thicker in BMS subjects. These two areas are key regions in the pain matrix; a brain network which controls various type of pain including allodynias. Interestingly for these two regions DYS group presented intermediate but not significantly different cortical thickness, as compared to BMS and Ct groups. The VBM analysis showed additional results. A comparison between BMS and Ct showed higher grey matter concentration in piriform and amygdala as well as in the precentral gyrus and inferior frontal operculum. Apart from the piriform and amygdala, the grey matter concentration of these last regions correlated with pain level. Interestingly both BMS and DYS subjects presented a reduced grey matter concentration in the anterior cingulum gyrus. This last variation correlated also with pain level in both groups. As a conclusion, burning mouth and dysgeusia syndroms both involve significant rearrangement of the cortex, more precisely in areas linked to pain perception and pain control. Because the cortical rearrangements observed are rather similar in burning mouth and dysgeusia syndroms although more pronounced in BMS, it is likely that both pathologies are not clearly separated.

Determinants of human olfactory performance: a cross-cultural study

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Olfaction allows us to detect subtle changes in our environment, but sensitivity of sense of smell varies among individuals. Although a significant number of research papers discuss the relationship between olfactory abilities and environmental factors, most studies have been conducted on Western populations or in developed Asian societies. The potential environmental and cultural determinants of olfactory acuity warrant further exploration. In the current study, we compared previously published data on olfaction in an industrialized, modern society (i.e., Europeans) and an indigenous society living in unpolluted, natural environmental conditions (i.e., Tsimaneâ€™), with novel data on the olfactory acuity of inhabitants of the Cook Islands. Like the European population (and contrary to the Tsimaneâ€™), the Cook Islands people form a modern society, and like the Tsimaneâ€™ population (and contrary to the Europeans), they live in an unpolluted region. Thus, these comparisons enabled us to independently assess the importance of both air pollution and changes in lifestyle for olfactory abilities in modern societies. Our results indicate that people from the Cook Islands had significantly higher olfactory acuity (i.e., lower thresholds of odor detection) than did Europeans and Tsimaneâ€™ people. Interestingly, the olfactory sensitivity of Europeans was significantly lower than the olfactory sensitivity of the remaining two groups. Our data suggest that air pollution is an important factor in the deterioration of sense of smell. However, it is also possible that factors such as agricultural and/or cooking practices, alcohol consumption, and access to medical service may also influence olfactory acuity.

Olfaction in Allergic Rhinitis - A Systematic Review

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Domestication effect and sensory value in strawberry - Breeding the flavour out off our fruits?

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Different smell ability in subjects with anomia

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Introduction: There is difference of olfactory and trigeminal sensitivity in subjects suffering from anosmia. To find these subtle differences the Test of Odor Pleasantness (TOP) could be suitable for this purpose. This test is based on evaluation of odorants with strong hedonic characteristic and stimulants include not only olfactory, but also trigeminal stimuli. The goal of the study was to discriminate subjects with anosmia based on their residual olfactory and trigeminal function.

Patients and methods: We included 69 subjects (30 men) suffering from anosmia in the study. Anosmia was stated by Odorized Markers Test and Sniffin' Sticks test (part identification). Further, TOP was used to evaluate olfactory and trigeminal function. Patients were asked to classify the odorants into 4 categories – pleasant, neutral, unpleasant, or very unpleasant.

Results: From 69 patients 25% were not able to smell and categorize any of the odorant, 10% recognized trigeminal stimuli and 65% were able to smell and classify some of the other odorant. Considering etiology, 86% of subjects with postviral anosmia could not smell anything. 22% of patients suffering from posttraumatic anosmia could recognize trigeminal stimulants. Patients with sinonasal disease could classify some of odorants in most cases (52%).

Conclusion: The TOP is suitable for differentiating subjects with anosmia into three subgroups according to their ability to smell something, to recognize trigeminal stimulants, or without ability to classify stimulants. These results could be helpful as a prognostic factor.

Olfactory training with older people

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Aim and Background: Loss of olfactory function is largely found with aging [4]. Such a reduction in olfactory function affects quality of life and enhances likelihood of depressive symptom. Furthermore, it has been shown, that reduction in olfactory function is associated

with cognitive impairment [5] and several diseases such as Major Depression [1,2] or Parkinson´s Disease [3]. Because several studies suggest that discontinuous exposure to certain odors may improve general olfactory function, the aim of this study was to investigate whether such "olfactory training" has positive effects on subjective wellbeing and cognitive function.

Material and Methods: Up to now, 63 participants (aged 50 to 84 years) completed testing in our ongoing study. They were randomly assigned to an olfactory training group (N=44) and a control group (N=19). The study includes two appointments at the Smell and Taste Clinic, where olfactory and cognitive function as well as subjective well-being were tested with standardized tests. In the meantime, the training group completed daily olfactory training over a period of five months. During the same time the control group completed daily Sudoku problems.

Results and Conclusion: Preliminary analyses show a significant improvement of olfactory function in the odor training group, and a tendency for improved cognitive function and subjective well-being. Based on these first results "olfactory training" may constitute an inexpensive, simple way to improve quality of life in older people.

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Olfactometry using time-frequency analysis

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The measurement of olfactory event-related potentials is time consuming and costly. Previous studies have shown that the time-frequency analysis provides additional information regarding central odor processing. Not only time and phase locked events but also changes in EEG frequency, which are not phase locked, can be detected. This opens new possibilities for odor presentation. Therefore aim of this study was to develop an easy to use and inexpensive way of "objective" olfactometry.

Forty, young (age 18-33 years), healthy and normosmic volunteers were tested. A self-built olfactometer with an air flow rate of 2l/min was used for stimulus delivery. EEG was recorded during stimulus presentation and processing. The data was analyzed using the Letswave toolbox for Matlab applying the time-frequency analysis. Using the following stimulus properties the best results were achieved: 1s stimulus duration, 18-22s inter stimulus interval, random sequence of the stimuli and cued stimuli. EEG frequency changes were noticeable due to both trigeminal and olfactory stimulation. Compared to the control condition these changes were significant for olfactory ($p<0.01$) and trigeminal stimuli ($p=0.031$). ROC analysis revealed a good sensitivity and specificity for distinguishing between the stimulation condition and control (olfactory stimulus: 90% sensitivity, 80% specificity;

trigeminal stimulus: 60% sensitivity, 100% specificity). Based upon these results this technique seems appropriate for “objective” olfactometry.

Olfaction in animal models of disease

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Olfactory perceptual problems are co-morbid with a surprisingly diverse array of physical and psychiatric disorders. This may in part reflect the complex central processing and neural plasticity involved in perception of odor objects. Here, I will review current understanding of central processing of odors, and describe how this processing is impacted in distinctly different animal models of pathology.