

ECRO 2025 CONFERENCE

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Neural oscillation signatures of the human olfactory bulb: patterns in active and passive odor sampling

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Olfactory bulb, CRERP, EBG, Active and passive sampling, Gamma and beta oscillations

As the first and only relay station between the peripheral and central olfactory systems, the olfactory bulb (OB) plays a crucial role in human olfactory processing. This study investigated OB activity during active and passive sniffing of odors with different valences. We recruited 32 participants, dividing them into two groups: an active sampling group and a passive sampling group. Sixteen participants experienced odor delivery synchronized with their breathing (synchronous design), while the other 16 followed an asynchronous design. Electrobulbogram (EBG), a non-invasive scalp-based method, was used to record OB activity, with 64 channels on scalp and 4 external electrodes on forehead. Our results indicated that early gamma and beta oscillations may reflect the OB's role in initial odor encoding. Both active and passive sniffing exhibited similar patterns of repetitive high-gamma oscillations, potentially signifying rhythmic information refreshing. Additionally, mid-phase beta activation was observed during passive odor sampling, suggesting a greater reliance on intrinsic brain regulation. Furthermore, individuals highly sensitive to olfactory ERP tasks exhibited delayed EBG components, which may reflect individual differences in olfactory processing strategies influenced by higher cortical regions. In conclusion, gamma and beta oscillations are critical for OB function and may underlie different olfactory processing mechanisms in active versus passive sniffing. The results emphasize the role of OB dynamics in olfactory perception and suggest that passive and active odor sampling engage distinct but overlapping neural mechanisms.

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The attentional blink is not, is not, is not modulated by lavender vs. peppermint smell

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Type of abstract: POSTER

Subject area: Olfaction - Central processing

Keywords: attention; lavender; peppermint; attentional blink; visual attention

Lavender and peppermint are commonly utilized odors, believed to induce specific states in individuals—relaxation in the case of lavender, and alertness with peppermint. The possible (physiological or psychological) mechanisms through which these effects occur remain under discussion. Another area of debate is the cognitive processes that are influenced by odors. Our current research focuses on the topic of temporal attention, best examined through the attentional blink paradigm. In this paradigm, a rapid sequence of visual stimuli is displayed on the screen. The task was to attend to two target stimuli. Typically, the ability to accurately detect the second target stimulus (T2) decreases within 200 to 600 ms after the first target stimulus (T1); this is called the attentional blink (AB) effect. Colzato et al. (2014) reported some evidence suggesting that the AB can be modulated by different ambient odors: with peppermint increasing the AB compared to lavender. They proposed that lavender has a calming effects that might lead to reduced attention allocation to the task, attenuating the AB effect. In contrast, peppermint may heighten arousal, thus accentuating the over-investment in the task and enhancing the AB. Through a series of 3 experiments, we sought to replicate and expand upon this study by employing both trial-by-trial and block-wise odor presentations using an olfactometer. Across all our experiments (no external funding; with 112 human subjects who provided written informed consent and were treated according to ethical guidelines), we did not observe any evidence supporting modulation of the AB by peppermint (“Pfefferminze” from Primavera Life, Germany) compared to lavender (“Lavendel fein” from Primavera Life, Germany) odors. We compare our findings with those of Colzato et al., consider them alongside other empirical research in this area, and discuss them in relation to broader principles of how odors might affect cognition.

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The ablation of *Tas2r108* induced alterations of leptin and metabolism

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Type of abstract: POSTER

Subject area: Taste - Behavioral/perceptual

Keywords: *tas2r108*, bitter taste, life span, metabolism, feeding behavior, plasma leptin

The sense of taste is crucial for survival and maintaining quality of life. The taste receptors are mainly divided into the T1R family, which comprises receptors for sweet and umami tastes, and the T2R family, which includes bitter taste receptors. Specifically, the genes for the bitter taste receptors in humans (*TAS2R*) and in mice (*Tas2r*) have been identified, with 25 known genes in humans and 35 in mice. Our previous studies have shown that bitter taste receptors are expressed in the tongue with variations in expression levels depending on the gene. Notably, *Tas2r108* was the most highly expressed gene in taste papillae. This research aims to explore the probable physiological functions of the *Tas2r108* bitter taste receptor.

Tas2r108 knockout mice were created using CRISPR/Cas9 technology, and male *Tas2r108*^{-/-} mice were selected for studies. To confirm the long-term effects of *Tas2r108* knockout(KO), we monitored the normal processes of fertilization and pregnancy, as well as the lifespan and physiological indicators including body weight, blood pressure, blood glucose, and plasma leptin levels (approved in GWNU-2020-24-1).The ligand for t2r108 was identified through Ca²⁺ activity assays in CHO cells transfected with *Tas2r108*.

Tas2r108 responded various bitter substances including cycloheximide and denatonium. In *Tas2r108* knockout mice, the bitter taste sensitivity was changed. No significant changes in growth were observed during pregnancy or lactation periods.

The lifespan of *Tas2r108*^{-/-} mice was extended without the chronic metabolic diseases except for an increase in plasma leptin and mild overweight.

The results suggest that KO of *Tas2r108* would elicit change in metabolism or feeding behavior and/or would induce life span extension.

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Impact of smelling food odorants on salivary and emotional responses

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: food odorants, salivary cephalic phase responses, autonomic nervous system, heart rate variability, skin conductance, salivary biomarkers of stress

Food smell plays an essential role in ingestive behaviour, triggering psychophysiological responses, including increase salivation and changes in autonomic nervous system activity. The emotional states that food stimuli evoke may vary among individuals. Implicit methods, such as galvanic skin response or heart rate variability, have been proposed to infer arousal, whereas the analysis of facial expressions can detect valence. Saliva has also been used to access stress, however studies linking different measurements of emotional states evoked by food smells with saliva are missing. The present work aims to investigate how measures of emotional states are correlated with salivary levels of cortisol, amylase and oxytocin. We conducted a within-subject design study involving 41 healthy adults, from both sexes. Participants were exposed to 2 different food (vanilla and orange) and a non-food (pine) odorants randomly presented, and saliva samples were collected before and during 3-minute exposure to each odorant. Changes in the activity of the autonomic nervous system were measured through galvanic skin response and heart rate variability, and facial expressions were analyzed through appropriate software. Participants also rated the odors tested in study regarding liking and desire to consume foods containing those odorants. Preliminary results show that smelling food odorants seems to trigger a higher increase in saliva secretion in comparison to non-food. Despite the large interindividual variability in terms of emotional arousal, a clear difference from food to non-food odorants was observed. The association between arousal and valence measurements and changes in salivary cortisol, amylase and oxytocin will be presented. Studying physiological and emotional responses in anticipation to smell of food may offer insight into mechanisms underlying the regulation of ingestive behavior, highlighting the potential for multisensorial interventions targeting eating-disorders.

References

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Predicting human olfactory perception by odorant structure and receptor activity profile

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Type of abstract: POSTER

Subject area: Olfaction - Peripheral processing

Keywords: molecular representation, three-dimensional structure, predictive model, olfactory receptor

Objectives: The objective of this study was to clarify the relationship between molecular structure, OR activity profiles, and perceptual odor similarity and to build a calculation model to predict odors.

Methods: The degree of perceptual odor similarity to eugenol among eugenol, vanillin, and structurally similar compounds was scored, and OR activity profile of these compounds was evaluated. We also developed a new method to represent the molecular structure of odorants as 3D shapes and pharmacophore similarity fingerprints, considering the 3D structural similarities between various odorants with multiple conformations. Finally, we conducted structure-OR activity relationship analyses for predicting odor similarity.

Results: Our results indicated that eugenol - vanillin structurally similar compounds primarily activated six ORs, and the activity profiles of these ORs correlated with their perception. This enabled the development of a prediction model for the perceptual similarity score from OR activity profiles (coefficient of determination, $R^2 = 0.687$). These 3D shape and pharmacophore fingerprints could also predict the perceptual odor similarity score ($R^2 = 0.514$). Finally, we identified key molecular structural features that contributed to predicting sensory similarities in the structurally related compounds evaluated in this study.

Conclusions: Our models can predict odor similarity from OR activity profiles and the 3D structural similarities among odorants in narrow odor space. The odor prediction model using ORs activity data was more accurate than the model using the structure data. This suggests the usefulness of obtaining and using ORs data.

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References

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Sequence analysis and structural annotation of odorant-binding proteins (OBPs) and Niemann Pick C2 proteins (NPC2) from *Dermanyssus gallinae*

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: Odorant binding protein (OBP), Computational research, Molecular modeling, Molecular dynamic simulation, Chemical communications

Dermanyssus gallinae (Dgal), commonly known as the poultry red mite, is an ectoparasite that infests domestic birds, leading to significant losses in the poultry industry. Mites, a highly diverse group of arthropods, rely on chemical cues to detect their food, hosts, or prey in their environment. Odorant-binding proteins (OBPs) and chemosensory receptors play a crucial role in processing these signals. Sequence and structure annotation studies have not been performed for this species. This research employs bioinformatics approaches to investigate the members of six OBPs and chemosensory protein family of six NPC2s (Niemann-Pick type C2s) in Dgal. The results revealed significant sequence conservation, along with six pairs of cysteines forming disulfide bridges that ensure structural integrity, which are present in all protein sequences except OBP5. Through evolutionary tree analysis, the results indicate that DgalOBP1-5 and OBP6 have diverged into two distinct clades, while NPC2-4 and 6 also grouped into separate clades, associating with different mite members rather than the ticks lineage. Furthermore, the 6 OBP and 6 NPC2 structures were predicted by TrRosetta tool, which is web-based platform for fast and accurate protein structure prediction and validated by molecular dynamic simulation (MDS) analysis. DgalOBPs are alpha helices, like insect OBPs, while DgalNPC2s are mainly beta sheets. The DgalOBP3/4 and NPC2-5/6 proved to be more stable in the value of root mean square deviation (RMSD). Therefore, the study will enable us to conduct receptor-ligand interactions with selective disturbing compounds in the future.

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Vomeronasal organ condition in 5XFAD Alzheimer mouse model: preliminary results of a histological study

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Type of abstract: POSTER

Subject area: Olfaction - Peripheral processing

Keywords: Vomeronasal organ, mouse, Alzheimer's disease, aging, pathology, histology

The vomeronasal organ (VNO) plays a crucial role in chemical cues detection and animal behaviour. Recent studies revealed that this organ can be affected by degenerative changes induced by natural and pathological aging in mice, strongly affecting the vomeronasal sensory epithelium (VNSE) and reducing semiochemicals detection. Since the Alzheimer's disease (AD) induces olfaction deficits, the aim of this study was to evaluate if also the VNO can be affected by cellular changes in a commonly used AD mouse model, the 5XFAD. The protocol was approved by the Italian Ministry of Health (authorization n. 406/2021-PR of the 04/06/2021) and involved 48 VNOs from 24 5XFAD mice and 36 VNOs from 18 wild type mice, which were submitted to histological analysis (hematoxylin-eosin and PAS stain) to assess the presence of VNSE vacuolization and degeneration, VNSE thickness and glycogen accumulation. The statistical analysis revealed that no differences were observed between the two groups concerning the presence of vacuolization (MOLR, $p=0.79$) and degenerative changes (MOLR, $p=0.22$) of the VNSE. In WT and in 5XFAD mice, VNSE mean thickness was $103,18 \mu\text{m}$ ($\pm 17,61$) and $103,69 \mu\text{m}$ ($\pm 10,19$), respectively, with no statistical difference among the two genotypes (GLMM, $p=0.9$). Similarly, glycogen accumulation, assessed on PAS-stained sections, did not differ among groups (GLMM, $p=0,12$). Interestingly, also WT mice presented higher VNSE degeneration levels than our previous studies in mice of different strains of similar age. These preliminary results seem to suggest that the pathological aging induced in the 5XFAD AD mouse model does not affect the condition of the VNSE compared to WT, as we previously observed in natural aging. Finally, VNSE conditions of the WT mice suggest that the choice of the model is a crucial stage in semiochemical research, since it is possible that the strain can influence the condition, and possibly the functionality, of the VNO.

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Towards a Chemosensory Understanding of Modified Peptides: a BILN-based Graph Neural Network for Bitterness Prediction

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Type of abstract: POSTER

Subject area: Taste - Behavioral/perceptual

Keywords: Bitter, GCN, Peptides, AI, Machine Learning, BILN

Taste is a key factor in food choices and significantly influences overall health. Food processing can generate peptides, including modified peptides, through enzymatic hydrolysis, fermentation, or thermal treatment. These peptides may develop an unpleasant, bitter taste. Predicting the bitter taste of peptides early on will enable the optimization of processing methods.

However, incorporating chemical modifications poses unique challenges in representing peptides for machine learning applications. Traditional line-notation formats, such as FASTA, offer a simplistic view of sequence identity but fail to capture structural and functional complexities, such as cyclization and peptide modification. Conversely, Boehringer Ingelheim Line Notation (BILN) offers a robust framework for encoding these complex peptides.

We propose a bitter peptide predictor that uses BILN notation. Translating BILN notation into structured graph representations has allowed us to bridge the gap between computational precision and biological relevance. The model enables accurate assessments of peptide-induced sensory responses.

Accurately predicting the taste properties of peptides is essential to advancing alternative protein development as the presence of bitterness can negatively impact consumer acceptance.

Omega-3 fatty acids and their influence on feeding behavior in rainbow trout: unraveling the sensory mechanisms

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Type of abstract: POSTER

Subject area: Taste - Behavioral/perceptual

Keywords: Rainbow trout, sensing system, plant-based diet, omega-3, oxylipins, feeding behavior.

In the context of global aquaculture expansion, reducing reliance on wild fish stocks, still used to produce fishmeal and fish oil, remains a major challenge. Replacing these ingredients with plant-based alternatives is a key priority. However, their full substitution often reduces survival and growth in rainbow trout, from first feeding onward. Increasing evidence suggests that altered feeding behavior may contribute to these impairments, yet few mechanistic studies have addressed this. Marine ingredient exclusion also removes dietary omega-3 fatty acids (DHA and EPA), whose roles in feeding regulation remain unclear. Taste perception and nutrient detection are essential for assessing feed quality and ensuring adequate intake. Our research shows that dietary omega-3 levels significantly influence trout feeding preferences and behavior. Moreover, diet type (marine vs. plant-based) modulates sensory nutrient detection, particularly via omega-3-sensitive receptors in gustatory and olfactory tissues. Notably, even short-term plant-based feeding (one meal or 30 days) alters serotonergic signaling—key for taste transmission and behavioral regulation. Our results also reveal the involvement of free fatty acid receptors (FFARs) in feeding behavior regulation, even from early life stages. These findings highlight how plant-based diets can disrupt feeding responses and reveal trout's high sensitivity to dietary signals. They emphasize the importance of early nutritional programming on sensory function and central control of feeding. This work addresses critical challenges in sustainable aquaculture by supporting the development of improved feeds and identifying biomarkers of dietary resilience under environmental change.

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Creating an atmosphere for giving: How pleasant scents but not pronouns foster charitable intentions

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Charitable behavior; olfaction; perfume; social behavior

Charitable behavior, for example donating money to charitable organizations, is important for social cohesion and fostering equality. The psychological mechanisms underlying charitable behavior, the influence of specific linguistic constructions on charitable behavior, or the influence of smells on it, are not well understood. By examining the impact of linguistic cues (inclusive pronouns) and sensory cues (social presence-signaling odors that are pleasant but unfamiliar, in combination with familiar scents), this study tests whether the congruence of these cues enhances prosocial behavior more effectively than their individual effects. Participants ($N = 161$) enrolled in a mixed-design study with two factors: pronoun condition (between-subjects: 'you' vs. 'we') and odor condition (counterbalanced within-subjects: own smell, other smell, 'we' smell, odorless control). Specifically, participants were exposed to 4 odors, while reading matched texts about 4 charitable organizations, manipulated for pronoun usage. After reading and smelling, they responded to measures of donation intention and attitudes toward each charity. Although the pre-registered interaction between pronoun and odor was not observed, the findings showed pleasant and familiar smells significantly enhanced immediate and future donation behavior and attitudes toward the charity, consistent with theories emphasizing the importance of positive affect and trust in promoting social behavior. The follow-up correlation analyses for smell perception suggest that these effects were in particular driven by the pleasantness of the smells, and were not due to the familiarity per se. There were no main effects for pronoun condition, suggesting comparable charitable intentions following reading advertisements that use 'you' versus 'we'. These results offer actionable insights for charities, suggesting that creating a pleasant olfactory environment has a greater impact on donations than specific language choices.

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The benefits of an early olfactory awakening for the development of conscious olfactory skills

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Type of abstract: POSTER

Subject area: Olfaction – Development

Keywords: olfactory awakening, olfactory skills development, developmental trajectories

In western societies, sensory awakening neglects olfaction, despite its essential role in feeding, danger avoidance and overall development. Some studies report olfactory performances in young children from birth. Scarce studies further show that young children can pay attention to olfactory stimuli when invited to do so. However, how an awakening olfaction intervention promotes the early development of early olfactory skills has not been described yet. This is the aim of the present pilot study of the EVOLF project, carried out in a nursery from Normandy (France).

A follow-up of 13 children (7 males) from 16 to 42 months ($M = 31 \pm 10$ months) began after obtaining written ethical agreements, as well as parental permission. The children were videotaped facing natural scented objects presented successively, during 3 phases : before, during and after an olfactory awakening intervention. Using The Observer® XT17 (Noldus), two independent observers annotated, in number and duration, the actions of smelling and looking at the object immediately after odorant detection, that reveals a conscious olfactory detection. They also recorded the duration of behavioural inhibition. The observations were reliable ($k > 0.8$).

Wilcoxon tests, comparing the target behaviours displayed during various phases, were first calculated to estimate the impact of the intervention. But, since we were unable to recruit a control group with similar characteristics than those of the group awoken, and because only 9 children were followed-up until the end, individual developmental trajectories were also compared.

The results revealed a significant change in olfactory exploration during and after olfactory awakening ($p < 0.05$). However, individual developmental trajectories varied. Inhibited children did not explore odorants. This pilot study proves that early olfactory awakening allows the emergence of conscious olfactory skills, but also that behavioural inhibition blocks children's cognitive engagement.

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Episodic olfactory autobiographical memory and the persistence of self.

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: Olfactory Autobiographical Memory; Episodic Memory; Sense of Self; Persistence of Self; Embodiment; Environmental Embeddedness

Remembering smells is often claimed to be special. Odors allegedly mentally transport us back to a time and place with a strong sense of presence and vivid emotional engagement. Additionally, both psychologists and philosophers have converged on the idea that autobiographical memories (AM) play an essential role in generating our persisting sense of self. However, it is still an open question “What, if anything, olfactory AM contribute to our persisting sense of self?” Building upon a survey of the experimental and theoretical literature it is argued that olfactory AM are not special in generating a phenomenologically more emotionally vivid connection to the past. Rather, they play an important role in grounding our persisting sense of self. The smell component of AM provides purchase in situating ourselves within an autobiographical episode by providing a sense of embodiment and embeddedness within these historical contexts beyond that provided from other perceptual modalities. Moreover, a further speculative conclusion is offered that the occurrence of olfactory aspects within multi-modal AM can be employed as a means of validating the corresponding accuracy of the episodes depicted by long-term AM memories.

The hidden burden: the overlooked psychological toll of body odour in everyday life

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Olfaction, wellbeing, questionnaire

These days there is a lot of interest in body odour as a carrier of chemical signals enabling communication from a sender to a receiver. What tends to be overlooked is the explicit quality of body odour as mostly unpleasant which can impact the sender's psychological wellbeing. We developed the UnderarmCARE (Condition and Affective Response Evaluations) Questionnaire to quantify the impact of (non-clinical) underarm issues on the quality of life of healthy individuals.

Methods: The questionnaire has 3 subscales (Sweating, Odour, and Skin issues) that were developed through a multistep iterative process followed up by exploratory and confirmatory factor analysis. It was administered online along with the Perceived Stress Scale (PSS), the Sleep Health Index (SHI), and self-reported assessments of irritation, sweat, and malodour rate, frequency and concern to 1184 participants in the USA.

Results: The data was randomly split into Sample 1 and Sample 2 for initial exploratory self-perceived and confirmatory factor analysis. Scores from all three subscales were negatively correlated with the PSS and positively correlated with the SHI, suggesting that lower underarm wellbeing is associated with higher stress levels and worse sleep. Additionally, self-reported assessments of underarm sensitivity, sweat, and malodour were negatively correlated with underarm wellbeing, indicating that increased frequency, rates and concerns in these areas are linked to decreased overall wellbeing. The 3 subscales were reduced from 75 items to 25 items with good reliability.

The UnderarmCARE Questionnaire is a valid tool for quantifying self-perceived underarm wellbeing and its impact on the quality of life of healthy individuals. It can be used to gain valuable insights into how body odour affects social and emotional wellbeing as well as to assess possible improvements produced by deodorant products to address these issues.

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References

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Super-resolution shadow imaging reveals anatomical and morphological details of the mouse vomeronasal sensory epithelium

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: Vomeronasal Sensory Neurons, Morphology, Vomeronasal Organ

In most mammals, the accessory olfactory system plays an important role in the detection and processing of both inter- and intraspecific chemical cues. The vomeronasal organ forms the system's peripheral sensory structure. It is a blind-ended tube, divided into three principal compartments: (i) a crescent-shaped mucus-filled lumen, into which stimuli are actively drawn by contractions of (ii) a lateral cavernous tissue, and (iii) a sensory epithelium that harbors vomeronasal sensory neurons (VSNs). Surprisingly, we still lack detailed information on many aspects of vomeronasal anatomy and VSN morphology. Here, we quantify and characterize morphometric features of the vomeronasal sensory epithelium, and VSNs in particular, in live tissue. We use super-resolution shadow imaging, a method that stains the extracellular space with fluorophores prior to super-resolution (STED) imaging. We then reconstruct and analyze the resulting shadow images both manually and with machine learning-based approaches. We investigate acute tissue slices on different levels. First, we assess macro-scale properties of the sensory epithelium, including general cell count and the cellular-to-interstitial volume ratio. Second, meso-scale analysis addresses VSN morphometry and its correlation with epithelial location. Third, we examine micro-scale features of subcellular VSN compartments, including soma, dendrite, and knob morphologies. Finally, we compare general morphometric features to those of cells expressing a specific receptor type. Together, these findings demonstrate distinct heterogeneity in shape and morphometric features among mouse VSNs.

A Cre-lox technique to address olfactory dopaminergic cell functional heterogeneity

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Cre-lox; Dopamine; Olfactory bulb; Periglomerular cells; Sexual odors.

The main olfactory bulb (OB) is the first and only relay structure for odors before reaching the olfactory cortex and hosts the most numerous dopaminergic (DA) forebrain population. These inhibitory interneurons are typically identified by tyrosine hydroxylase (TH) expression and two main subpopulations can be recognized based on soma size, electrophysiological properties, and generation time. Although increasing evidence places the role of these cells in the early stages of sensory processing, their exact function remains unclear. Moreover, their high heterogeneity challenges the study of these cells and thus a specific method to target the two subpopulations differentially is required to study their properties and roles separately. To this aim, we validated a virally delivered, time-controlled Cre-lox technique that allows to express either morphological or functional reporters in the OB TH-positive cells selectively. The specificity of this labelling is comparable to that of the TH-GFP transgenic mouse line and can target TH-positive subpopulations enriched in either small or large cells whether it is performed in adult mice or in embryos and newborns, respectively. By expressing GCaMP indicators in TH-positive cells, we were able to perform in vivo two-photon functional calcium imaging experiments in anesthetized, head-fixed adult mice. This allowed the assessment of their spontaneous activity as well as their evoked responses to opposite-sex urine. Since we previously observed a specific TH-positive cell recruitment in the posterior OB of female mice exposed to male urine, our goal is to focus on this area while observing TH-positive cell function using our labelling strategy. Taking advantage of a multidisciplinary approach based on this OB DA cell targeting technique, our main aim consists in dissecting a possible differential role for the two DA subpopulations in processing ethologically relevant odors, specifically those associated to sexual behaviors.

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Perceptual deviance processing in odour mixtures is different for foods and non-foods

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Perception, Olfaction, Decision-Making, Contamination Sensitivity, Food Odour, Deviation Tolerance

The perception of an unfamiliar note in a familiar odour mixture can vary by context. For example, we previously found that participants were more likely to perceive food as contaminated by non-food odours than vice versa. This effect was driven by perceptual amplification of non-food components, a bias that persists despite changes in attentional focus, and might represent a protective mechanism against accidental ingestion of contaminants. However, these processing differences between food and non-food odours, particularly our tolerance for unusual notes, are still not fully understood. In the current study, we explored the effects of attention on the perception of odour mixtures composed of only food or non-food components. Participants ($N = 24$) assessed the perceived dominance of a target odour within an odour mixture. Analysis of response times (RT) showed both a linear ($\beta = 0.14$, $p < 0.001$) and quadratic term ($\beta = -0.01$, $p < 0.001$) with fastest RT for pure odours and slowest RT around the dilution series' midpoint. Decisions were also faster for food odours compared to non-food odours ($\beta = 0.25$, $p < 0.001$). The likelihood of perceived target dominance generally increased with target concentration ($OR = 2.6$, $p < 0.001$), but followed different patterns for the two target categories. While $p(\text{dominant})$ increased linearly with rising target concentrations for non-food targets, it exhibited a sigmoidal shape with a steeper slope (larger just-noticeable difference, JND) for foods than for non-foods. These findings imply that distinguishing two food odours may be easier than distinguishing between two non-food odours, likely due to clearer definitions of object categories. Conversely, individuals might exhibit lower contamination sensitivity in non-foods, allowing for greater tolerance of deviations. This work was funded by the European Research Council (Grant agreement No. 947886 to JS).

References

¹ European Research Council

Discrimination of intranasal electrical stimulation patterns and associative learning: neurophysiological and behavioral correlates

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Type of abstract: POSTER

Subject area: Multisensory - Central processing

Keywords: Trigeminal; electrical; olfaction; electroencephalography; associative learning

Using the trigeminal system as a substitution in the context of an olfactory implant has been proposed. This assumes that patients can differentiate between trigeminal stimuli and associate them with corresponding odorants.

The neural correlates of the perceptual discrimination between two patterns of intranasal electrical stimuli delivered at the septum were studied in healthy subjects and patients with olfactory loss using EEG. In the learning protocol, we examined whether the association between such patterns and the mental image of an odor would improve discrimination and recognition of these patterns. The protocol included four sessions: 1) an initial discrimination of the two electrical patterns, 2) & 3) 5-minutes associative learning phases, and 4) a final assessment of discrimination. To test discrimination, we gave subjects a random series of 24 triplets, each comprising two identical and one different electrical pattern, from each of which they had to choose the odd-one-out

Preliminary results (4 patients, 7 controls) suggest that patients were less sensitive to electrical stimuli than controls, but they could differentiate electrical patterns. Indeed, the two electrical patterns were generally rated as different in terms of intensity, pleasantness and irritation (two-way Wilcoxon test, $p < 0.04$). All participants performed the discrimination task above chance (two-way Wilcoxon test, $p = 0.004$), even though 3 participants had a low performance and none had perfect discrimination. In the time-frequency domain, the baseline EEG assessment of intranasal electrical processing revealed significant differences of theta, delta and beta oscillations between patients and controls, and between electrical stimulation patterns (ANOVA, $p < 0.05$).

In conclusion, healthy participants and patients are able to discriminate different types of electrical stimuli, which is also reflected at an electrophysiological level.

References

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State-dependent modulation of odor valence and social behavior via the main olfactory pathway

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

The perception of sensory stimuli depends not only on its physical properties but can be significantly modulated by the internal state, experience and context. The olfactory system provides an ideal model to study modulation of perception and behavior, as it is heavily innervated by major neuromodulatory centers and chemosensory communication drives essential behaviors.

Especially, odor valence is a critical feature as it elicits appropriate aversion and attraction—motivated behaviors crucial for survival. Odor valence can also be significantly modulated by factors including internal state (e.g., hormonal status). Despite its importance, the mechanisms underlying encoding and modulation of odor valence remain poorly understood. In particular, how innate odor valence is encoded and modulated by non-conditioned factors like internal state remains unclear. Here, we identified a naturally occurring switch in behavioral valence responses towards a volatile social odor that depends on the neuroendocrine state. In this model, 1) the response of female mice to the male social cue trimethylamine (TMA) significantly depends on the estrus state; 2) This behavioral switch depends on a defined receptor, TAAR5, which is expressed in the main olfactory system and is specifically activated by TMA; 3) This switch in behavior is specific to TMA. This naturally occurring switch in odor valence provides a unique opportunity to study a non-conditioned, potentially inducible change in perception.

To identify neural circuits and molecular mechanisms underlying estrus-dependent modulation, we combine awake in vivo 2-photon calcium imaging with RNA sequencing of specific neuronal subtypes. Since valence responses to TMA are abolished in TAAR5-deficient females, we hypothesize that this receptor plays a critical role in social and reproductive behaviors. To test this, we developed a behavioral assay comparing wild-type and mutant females at different estrus stages interacting with males.

Insights into Adult Neurogenesis of Vomeronasal Sensory Neurons

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: adult neurogenesis

Neuronal turnover in olfactory epithelia ensures reliable detection of environmental cues throughout the lifetime of an animal. Thus, adult neurogenesis in mammalian olfactory epithelia persists throughout the lifespan of an individual. However, the precise physiological processes that govern adult neurogenesis in the vomeronasal organ remain elusive. Here, we begin to describe characteristics of neurogenesis in the mouse vomeronasal sensory epithelium. We label newly generated vomeronasal sensory neurons (VSNs) using a genetic approach: upon tamoxifen injection, VSN progenitor cells in *Id2CreERT2 :: Rosa26R-tdTomato* mice express tdTomato upon coincident *Id2* promoter activity. Descendants of these cells are thus identifiable by red fluorescence. Using the *Id2* proliferation and differentiation marker as a VSN lineage tracer, we describe the proportion of new-born neurons within the VSN population. We identify the spatial distribution and morphology of individual new-born neurons along with their age-dependent migration patterns within the sensory epithelium. Furthermore, our results offer insights into VSN turnover-rates. Finally, by analysing co-expression of different marker proteins, we evaluate the differentiation and maturation state of new-born neurons at different timepoints post injection.

Investigating the regenerative potential of the mouse vomeronasal organ

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: regeneration

The olfactory epithelium (OE) and vomeronasal organ (VNO) are continuously exposed to environmental insults such as toxins and pathogens. To maintain their vital functions both chemosensory epithelia depend on ongoing cellular turnover and robust regenerative mechanisms. Regenerative processes that maintain OE integrity, particularly the roles of globose basal cells (GBCs) and horizontal basal cells (HBCs), have been thoroughly described. By contrast, comparatively little is known about the regenerative potential of basal stem cell populations in the VNO. Here, we begin to investigate the regenerative dynamics of GBCs and HBCs in the VNO. Using immunohistochemical approaches, we (i) determine the abundance and proliferative capacity of GBCs and HBCs, (ii) describe their spatial distribution within the respective epithelia, and (iii) compare their relative proportions and localisation patterns. We aim to provide insight into whether and, if so, to what extent cellular mechanisms identified in the OE are conserved within the VNO. Together, these data enhance our understanding of epithelial maintenance and sensory neuron turnover in the vomeronasal system.

What Makes a Scent Trigger a Memory? A Cognitive Decomposition of Odor-Evoked Retrieval

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Odor-evoked memory Odor Recognition Odor Associative memory Familiarity Emotional salience Semantic distinctiveness Machine learning

A single scent can unlock vivid memories. This study investigates the factors that make some odors more evocative than others . We examined odor-evoked episodic memory in 106 participants who experienced odors embedded in distinct visuospatial contexts, and whose memory was tested 24-72 hours later. The protocol empirically dissociates odor recognition (“I’ve already smelled this scent”) and associative memory (“It evokes a memory”) processes. Using machine learning with SHapley Additive exPlanations, we identified distinct predictors for each process. Recognition was driven by emotional strength – especially for unpleasant odors – and the richness of verbal descriptions. Associative memory followed a U-shaped relationship with familiarity and was strongly influenced by semantic distinctiveness – how uniquely each odor was described. Together, these findings reveal that odor memorability depends not only on its emotional salience, but also on how specifically it is conceptualized and how familiar we are with it.

Highlights:

Dissociation of odor-evoked memory into recognition and associative processes.

Emotional strength, especially unpleasantness, drives odor recognition.

Familiarity follows a U-shaped relationship with associative memory.

Semantic richness and uniqueness enhance odor-evoked memory retrieval

Fundings

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Smell and Tell: The emergence of olfactory expertise in perfumery students

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: olfactory expertise, learning, perfume training, natural language processing, machine-learning

Developing olfactory expertise relies on the ability to describe, categorize, and conceptualize odors—skills that are crucial in professional perfumers. This first longitudinal study examines how a 1.5-year structured curriculum shapes perceptual, cognitive and linguistic dimensions of olfactory expertise acquisition. Forty perfumery students were assessed at three time points on odor description, evocation, recognition, discrimination, and categorization tasks. Results show significant improvements in verbal abilities, with students developing richer, more precise, and increasingly expert-like vocabularies. Using natural language processing and machine learning, we demonstrate that the emergence of a shared olfactory lexicon – driven by increased semantic richness and alignment among students and with expert references – was a strong predictor of expertise, while perceptual improvements remained modest. These findings underscore the importance of consistent language use in expertise development and suggest that conceptual and linguistic progress may precede perceptual refinement, offering insights for the design of more effective educational programs.

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Modulation of bulbar activity in a mouse model of impaired intrinsic excitability

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Type of abstract: POSTER

Subject area: Olfaction - Central processing

Keywords: excitability, mitral and tufted cells, olfactory bulb, electrophysiology

Intrinsic excitability regulation is a critical yet understudied aspect of adaptive neuronal plasticity, essential for maintaining stable neural activity in response to perturbations. Uncovering the molecular regulators of intrinsic excitability modulation is challenging due to its dynamic, cell-specific nature and the interplay between synaptic and intrinsic mechanisms. In the olfactory bulb headway has been made by discovering that the microphthalmia-associated transcription factor (Mitf) is specifically expressed in projection neurons (PN, mitral and tufted cells) and that in primary culture of knock-out mutant (MT) mice, the loss of Mitf results in hyperactive PNs. Using immunohistochemistry and cell whole cell patch clamp in acute slices this project assessed the role of Mitf in the transcriptional control of intrinsic excitability in bulbar PNs in a model where circuitry is maintained.

Compared to WT controls, Mitf mutants PNs have shorter axon initial segments (WT $25.42 \pm 0.4 \mu\text{m}$; MT $23.05 \pm 0.7 \mu\text{m}$; t-test $p=0.004$) that are closer to the soma (WT $4.7 \pm 0.2 \mu\text{m}$; MT $3.7 \pm 0.2 \mu\text{m}$; t-test $p<0.001$). These structural changes are alignment with the physiological hyperexcitability of MT PNs. In current clamp, MTs fired more action potentials (WT 32.1 ± 5.4 ; MT 51.0 ± 4.1 ; Mann-Whitney $p=0.013$) with shorter latency to fire (WT $23.6 \pm 3.1 \text{ms}$; MT $16.9 \pm 0.2 \text{ms}$; Mann-Whitney $p=0.029$). Moreover, after 30 minutes of home-cage exposure to 8 odours before slice preparation, Mitf MTs showed altered gain control and transcription of excitability-related genes compared to control littermates. Together these results offer a new perspective over the transcriptional control of homeostatic mechanisms that contribute to excitability.

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Blood biomarkers predict idiopathic taste dysfunction: a case-control study

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Type of abstract: POSTER

Subject area: Taste - Other

Keywords: Idiopathic dysgeusia Blood biomarkers Taste Strips

Taste dysfunction affects quality of life, yet its biological development remains poorly understood. This study explored differences in blood biomarkers between participants with and without taste dysfunction. We investigated clinical and biochemical differences in 50 patients with idiopathic dysgeusia and 102 healthy controls (110 women, 42 men; mean age 46.4 ± 1.4 years).

Following a detailed medical history, each participant underwent taste testing and blood analysis for iron, copper, zinc levels and iron metabolism (ferritin, transferrin), serum electrolytes, hematocrit, complete blood count, transaminases, creatinine, complement C3/C4 and ANA titers, using atomic absorption spectrometry among others.

Patients with idiopathic dysgeusia, who were older (61 vs. 39 years; $p < 0.001$) and predominantly females (86 vs. 66%; $p = 0.009$), were compared to healthy controls using age-adjusted statistical analysis. Taste performance assessed by "Taste Strips" was lower in patients, particularly for sour, bitter, and salty modalities ($p < 0.001$). They also reported higher scores on depression (Beck Depression Index) and mood questionnaires (Zerssen Mood Scale; $p < 0.001$). Blood analyses revealed that patients had higher levels of complement C4 ($p = 0.011$) and calcium ($p = 0.019$; ANCOVA), and a trend toward lower potassium ($p = 0.054$). A logistic regression model including age, gender, C4, Ca, K, Na, and transferrin predicted taste dysfunction with high accuracy ($R^2 = 0.742$; 91.4% correctly classified). Increased age, higher C4, Ca, and Na were associated with higher odds of taste dysfunction, while male gender, higher potassium, and transferrin levels were protective factors ($p \leq 0.030$).

These findings suggest that idiopathic taste dysfunction is accompanied by systemic immune imbalance while lower level of electrolytes may reflect a metabolic imbalance. These parameters should be included in clinical assessment. Further research is needed to explore causal mechanisms and clinical implications.

Foul and fragrant: differential naming of disgust eliciting odors

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Olfaction, disgust, language, perception

Being able to efficiently communicate about potential harmful stimuli in the environment is beneficial for survival. Therefore, disgusting odors, e.g., signaling danger and/or pathogens in the environment, are expected to be easier to describe compared to neutral or positive control odors. To test if disgust inducing odors are more nameable, the current study analyzed free responses to disgusting and control odors collected by Tybur et al. (2022). In Tybur et al. (2022), 5 disgusting and 5 control odors were described twice by 119 Dutch participants.

We hypothesized that disgusting odors had (a) a higher within-participant consistency and (b) longer responses, both indicating more proficient language use. Binary logistic regression showed that odor type significantly predicted within-participant consistency. Specifically, the odds of within-participant consistency occurring was 41% higher for disgust inducing odors compared to control odors. Thus, disgusting odors are described more consistent than control odors. Furthermore, linear regression showed that disgust inducing odors ($M = 73.28$, $SD = 38.60$) had a significantly longer response (measured with number of characters) than control odors ($M = 64.74$, $SD = 34.82$, $p < .001$). Thus, participants had significantly longer responses to disgusting odors.

Exploratory analyses showed what terminology was used for the different odor types. As expected, source terms were used the most. Additionally, binary logistic regression showed that odor type did not predict the use of source or abstract terms. Odor type did predict the use of evaluative terms, where disgusting odors were more likely than control odors ($b = 0.96$, $p < .001$). Odor type also predicted responses that showed uncertainty, where control odors were less probable than disgust inducing odors ($b = -0.55$, $p < .001$).

To conclude, disgust inducing odors were described more consistently and with a longer response compared to control odors.

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Differential regulation of neurofunctional and synaptic genes in the heads of *Apis mellifera* infected with Deformed Wing Virus (DWV-A)

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Type of abstract: POSTER

Subject area: Olfaction - Central processing

Keywords: *Apis mellifera*, Deformed Wing Virus, RNA-Seq, gene expression, nervous system

The Deformed Wing Virus (DWV-A) is one of the most prevalent pathogens affecting *Apis mellifera* colonies and has been linked to impairments in bee behavior and neural function, altering the insect's cognitive capacity. In this study, we analyzed the gene expression profile in the heads of bees with high viral loads (I-DWV; 1×10^{11} viral genome copies per bee) compared to those with low viral loads (N-DWV; 1×10^3 viral genome copies per bee), using RNA sequencing (RNA-Seq). Over 145 million reads were obtained, with an average mapping rate of 78.94%. A total of 9,113 transcripts were examined, identifying 147 differentially expressed genes (DEGs) ($s\text{-value} < 0.05$), of which 109 were upregulated and 38 downregulated in I-DWV bees. Gene Ontology (GO) enrichment analysis revealed 23 significantly associated terms, highlighting cellular processes related to intercellular communication and transmembrane transport. Specifically, we detected upregulation of genes associated with glutamatergic signaling, including Neuropilin and tolloid-like (Neto), Glutamate receptor ionotropic, kainate 2 (LOC102653800), Excitatory amino acid transporter 2 (Eaat2), and Sodium-dependent nutrient amino acid transporter 1 (Naat1), while Anoctamin-4 was downregulated. Additionally, Pfam domain analysis identified 77 enriched domains, highlighting those related to synaptic functions (CUB domain, receptor ligand-binding domain) and transcription factors associated with the nurse-to-forager physiological transition (Helix-loop-helix domain). In contrast, domains associated with stress responses (TPR and Hsp70) showed decreased expression. These results suggest that DWV-A infections profoundly affect the gene regulation of key processes in the nervous system of *A. mellifera*, including neuronal signaling, immune response, and functional plasticity, with potential repercussions on behavior and colony social organization.

References

- ¹ This study was supported by the FONDECYT N 1241994 grant from the National Research and Development Agency (ANID), Chile.
- ² This work was supported by the National Agency for Research and Development (ANID), Chile, through the National Doctoral Scholarship (No. 21201234)
- ³ This study was supported by : Programa de Doctorado en Ciencias de la Agronomía, Facultad de Agronomía, Universidad de Concepción, Chillán, Chile.

Location Matters: Mucus Moves Slower in the Olfactory Cleft Than at the Lateral Nasal Wall

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: mucus, olfactory cleft, mucociliary movement, middle turbinate, nasal endoscopy

Objectives: To assess and compare intranasal mucus movement based on location (olfactory cleft [OC] versus the lateral nasal wall at the level of the attachment of the middle turbinate [MT]) and material (particulate matter - silver flakes vs. liquid - methylene blue gel).

Methods: In this cross-sectional study, 59 healthy, normosmic adults (38 women, median age: 24 years) were evaluated. Mucus movement was endoscopically observed (30° Hopkins endoscope, Karl Storz, Tuttlingen, DE) and video-recorded with participants seated upright. Silver flakes (~1-2mm²) or one drop of methylene blue dye in Xylometazoline hydrochloride nasal gel (Nasengel AL 1mg/g, Aliud Pharma, Lachingen, DE) were applied to the olfactory cleft (silver flakes only) and the base of the MT (both materials) using a microsuction tube, without prior nasal decongestion or anesthesia. Olfactory function was assessed using the "Sniffin' Sticks" Odor Identification Test (Burghart, Holm, DE).

Results: Silver flakes placed on the MT exhibited movement within 2 minutes, whereas flakes in the OC showed minimal to no movement even after 7 mins ($\chi^2_{1,45}=19.9$, $p<0.001$). Mucus movement from the MT was predominantly in an anterior-inferior direction, in contrast to the OC where movement was absent or minimal ($\chi^2_{4,45}=29.9$, $p<0.001$). Among participants assessed with both materials at the MT (n=24), 58% showed consistent anterior-inferior movement (Fisher Freeman Halton Test=17.1, $p<0.02$).

Conclusions: Consistent with previous studies, mucus at the lateral nasal wall moves rapidly (within 2 minutes) in an anterior-inferior direction, whereas mucus over the olfactory cleft remains largely stationary even after 7 minutes. These findings demonstrate distinct regional differences in mucociliary movement within the nasal cavity.

References

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Decoding the bitterness of food-derived peptides

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Type of abstract: POSTER

Subject area: Taste - Central processing

With the increasing world population, the demand for nutritious foods is rising. One partially essential macronutrient is protein and hence are peptides and amino acids; nevertheless, it was found that a variety of peptides and amino acids elicit an aversive bitter taste, diminishing the food's quality and consumers' acceptance. Generally, bitter taste initiates an innate aversive reaction to avoid the ingestion of potentially pharmacologically active substances. In humans, about 25 G protein-coupled receptors are responsible for sensing bitter taste. Five of these bitter taste receptors were identified as bitter peptide receptors, namely TAS2R1, -R4, -R14, -R39, and -R46 with tritryptophane being a potent activator. As bitter-tasting peptides are abundant in a plethora of foods such as dairy, or plant products, it is crucial to understand the reason behind this off-taste to increase food quality.

In our work, with the usage of functional cell assays, we were able to show, that, starting from the potent bitter peptide tritryptophane, an extension of the peptide chain with further tryptophanes modifies the receptor response. Also the position of the amino acid tryptophane either on the C- or N-terminus is important for human bitter taste activation. Further, we were able to identify a bitter peptide motive in the off-tasting Gouda peptide YPFPGPIHN as well as the corresponding activated human bitter taste receptor. Multidisciplinary cooperation between computational, sensory, and *in vitro* approaches enabled us to generate and verify a prediction model for the bitterness of peptides. All in all, we managed to identify several factors that contribute to the off-taste of food-derived peptides, such as length, amino acid composition, and position. These insights, will help to increase the quality and acceptance of nourishing foods.

Funding was provided by the Deutsche Forschungsgemeinschaft (DFG) (BE 2091/7-1, PI 1672/3-1, DA 2112/3-1).

Stress-associated and neutral human body odors differ in their effects on facial emotion recognition.

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: stress body odor, neutral body odor, social communication, facial emotion recognition, social anxiety

The transmission of social signals via olfactory cues (i.e. chemosensory signaling) is essential for social communication across numerous species. Yet, surprisingly little is known about the effect of chemosensory signaling on human social behavior. While recent evidence suggests that human body odors convey socially relevant information such as emotional states, the precise socio-affective processes mediating the potential effects of human chemosignals on social behavior remain elusive. In this study, we investigated how exposure to human body odors affects emotion recognition from facial expressions - a key component of effective social communication. A sample of 37 healthy male participants performed an emotion recognition task while being exposed to three different chemosensory conditions in a within-subjects design: stress body odor (sampled from an independent male sample during the Trier Social Stress Test for Groups, TSST-G), neutral body odor (sampled during the control condition of the TSST-G) and a non-human control odor (damped cotton pad without human body odor). Face stimuli varied in emotional valence (anger, happiness, neutral) and intensity (low, high), and participants indicated by button press whether they perceived an emotional state in each presented face. Preliminary results suggest that exposure to neutral body odors improved overall emotion recognition. Additionally, participants' anxiety seems to modulate the effect of body odors on emotion recognition. These findings highlight the role of chemosensory signals in human social cognition and behavior and may encourage further research to investigate the effect of chemosensory communication in clinical conditions associated with altered social interaction and emotional processing. This research was funded by the University of Freiburg.

Can eating creative food make you more creative?

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Type of abstract: POSTER

Subject area: Multisensory - Behavioral/perceptual

Keywords: Culinary creativity, creative thinking, cognition

Surely most of us recognize the phrase ‘You are what you eat’. However, is this also true when eating creative food? This study explores whether creatively prepared food - defined by novel combinations of ingredients, visually striking presentations, or distinctive taste profiles - can enhance cognitive creativity compared to conventionally presented dishes.

A total of 102 healthy participants were randomly assigned to consume either a creatively prepared food sample (fruit/vegetable lasagna) or a less creative but nutritionally identical version (fruit/vegetable purée). Participants completed two standard creativity tasks for assessing convergent and divergent thinking, the Remote Associates Test (n correct out of five) and the Alternative Uses Task (fluency, n different uses; flexibility, semantic distance from prompt word), both before and after eating.

Contrary to our initial hypothesis, only participants who consumed the low-creativity sample showed an increase in performance on the flexibility measure of the Alternative Uses Task. We speculate that this counterintuitive result may be linked to the violation of hedonic expectations: the familiar appearance of the purée might have led to strong prior expectations that were then disrupted by the taste profile of the sample, resulting in a prediction error. Such surprise or cognitive dissonance could have transiently boosted divergent thinking.

These findings suggest that the cognitive effects of food presentation may depend less on novelty per se and more on how presentation interacts with consumer expectations. In this view, surprise, rather than creativity, may be the key mechanism by which food can modulate cognition.

This study was funded by the Novo Nordisk Foundation (NNF23OC0082731).

A transformer-based approach to predict cellular organization principles in iPSC derived olfactory organoids

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Type of abstract: POSTER

Subject area: Olfaction - Development

Keywords: deep learning, iPSC, organoid, olfactory development, vision-transformer

The advantages of employing three dimensional in-vitro culture systems come with the price of varying cytoarchitectural as well as protein expression heterogeneity. Thus, organoid to organoid as well as batch to batch intervariability in differentiation outcomes following the same protocols remains a central challenge in developmental biology. Our lab-intern grown induced pluripotent stem cell-derived olfactory placode organoids vary in their volume, cellular organization as well as their protein expression patterns. Immunofluorescence staining remains as a method to truly assess and confirm the cellular identities of cell cultures.

In this study, we established a pure Vision-Transformer based approach to accurately predict the cellular identities of olfactory placode organoids, which were categorized into three classes for the expression of (A) epithelial, (B) neural and (C) olfactory placode protein markers based on bright-field images which were acquired beginning on 12 of differentiation and later validated using immunofluorescence staining of 5 key protein markers on single organoid level. We fine-tuned 10 different pre-trained Transformer-based architectures on a training data set of 300 bright-field images of organoids, on which we performed on-the-fly augmentation. The data was each split into 5 folds to perform 5-fold cross validation.

The ensemble model of the vision transformer predicted the never before seen test data set of organoids with an overall accuracy of 73,3%, far exceeding the independent expert group with 57,21% tasked with labelling the same bright-field images of organoids on day 12 of differentiation.

Our study suggests that a Vision Transformer-based model can reliably infer early cell fate trajectories in olfactory placode organoids by offering a label-free, non-invasive alternative to traditional immunostaining, enabling early prediction of differentiation outcomes as early as day 12.

All funding was granted by the University of Tübingen.

References

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Forest vs. urban environment exposure is associated with improved well-being and compositional nasal microbiome changes

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: Affect, well-being, nasal microbiome, forest exposure

The benefits of nature contact for human well-being are well-recognized, yet much remains to be understood about the underlying causal mechanisms. This pilot study employed a natural experimental design with students at the University of Washington in Seattle, WA (USA) to explore the potential role of the nasal microbiome in mediating psychological well-being improvements associated with an 8-week immersion in a forest vs. urban environment. After the academic year, during which all participants (N=13) were full-time students in Seattle, one group of students relocated to remote forest sites in western Washington for 8 weeks (N=5; forest condition), while another group of students remained in urban Seattle (N=8; urban condition). Self-reported affect and psychological well-being were assessed pre- and post-exposure using validated surveys, and nasal swabs were collected pre- and post-exposure for bacterial 16S rRNA gene sequencing.

The forest group exhibited significantly greater improvements in affect ($p < 0.05$) over the 8-week exposure relative to the urban group. No between-group differences in overall nasal bacterial community composition were detected pre-exposure, but significant compositional divergence was observed post-exposure ($p < 0.01$), with the forest group exhibiting higher bacterial richness than the urban group ($p < 0.05$). The forest – but not urban – group also exhibited significant enrichment (FDR < 0.05) over time in bacterial genera with established links to well-being, including *Bifidobacterium* and *Akkermansia*. Increases in bacterial richness and the relative abundance of these genera were significantly associated ($p < 0.05$) with affective improvements over time. These findings provide evidence that suggests the nasal microbiome may be part of the mechanism through which nature contact benefits psychological well-being. This work was supported by funding from University of Washington's Center for the Studies of Demography and Ecology.

References

¹ This work was supported by funding from University of Washington's Center for the Studies of Demography and Ecology.

Odor naming as a tool for cognitive and perceptual assessment

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: odor naming; odor identification; cognitive abilities; odor vocabulary; natural language processing; semantic analysis

Tests of cued odor identification (OID) are often used as an assessment tool in cognitive, neuropsychological, or aging research. Due to the difficulty of naming odors, free OID (i.e. odor naming) is less frequently used. When free OID is used, a binary scoring model (i.e. correct or incorrect) is generally applied to each trial. This approach ignores the additional information available in odor misnamings (e.g., naming strawberry odor as peach) and odor naming omissions (i.e., complete failure to provide a name). Using data from a large-scale dataset collected in Sweden (SNAC-K; n=2280), we show that odor misnamings contain important information about olfactory-perceptual and olfactory-semantic abilities, and that free OID draws on a broader range of cognitive abilities than cued OID. A high frequency-of-use of odor misnamings that are specific and concrete (e.g., cinnamon) rather than vague and abstract (e.g., sweet), that are low in frequency, and that are semantically similar to the target odor name is associated with better OID performance. Further, whereas cued OID performance only is associated with an estimate of perceptual ability, perceptual speed, free OID outcomes (i.e., correct namings, misnamings and omissions) are additionally associated with verbal fluency, vocabulary, and episodic memory proficiency. We suggest that free OID / odor naming is an underutilized tool for cognitive and perceptual olfactory assessment, especially if the full breadth of the data available in correct namings, misnamings and omissions can be harnessed.

References

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Machine learning of an electronic nose as a tool, to monitor key biomarkers of food spoilage.

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Type of abstract: POSTER

Subject area: Olfaction - Development

Keywords: Electronic Nose, Smell Inspector, Food spoliage, Trimethylamine.

Machine learning of an electronic nose as a tool, to monitor key biomarkers of food spoilage.

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Introduction

The main objective of this article is to demonstrate the capability of the electronic nose made from carbon nanotubes to detect trimethylamine (TMA). For the tests, the "Smell Inspector" device was used — a prototype electronic nose developed by the company SmartNanotubes. The device is accompanied by software for data processing, which also enables the creation of predictive models using artificial intelligence.

Material and Methods

Trimethylamine (Fisher Thermoscientific) was chosen as the final marker of putrefaction. An initial stock dilution (1:1000) was prepared, from which further dilutions ranging from 1:9000 to 1:10,000 were made. These were placed in Erlenmeyer flasks with a mouth diameter of 4 cm and a volume of 1 L (Kriz, P. et al., 2023; Peters, R., et al., 2023; SmartNanotubes, 2022), and exposed to the sensors for 5 minutes, generating the data needed for training and subsequent odor recognition by the device. With training at different concentrations, it is expected that a portable device capable of real-time prediction of compound presence can be developed.

Results

https://docs.google.com/document/d/1rzO-KbJVlfdaZzrdObFNjq_x5E_eS2zA/edit?usp=drive_link&ouid=112057683091549866309&rtpof=true&sd=true

Graphs show blank and trimethylamine dilutions data acquired by device at different TMA perception channels.

Conclusions

This study demonstrates that, although much work remains to be done, the electronic nose has the potential to become an excellent method for quality control, especially in fish markets. This work has been fully funded by the Basque Culinary Center.

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Inputs to dopaminergic neurons in the mouse olfactory bulb

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Type of abstract: POSTER

Subject area: Olfaction - Central processing

Keywords: Olfaction; olfactory bulb; dopamine; patch clamp; glomerular interneurons; circuitry

Dopaminergic (DA) neurons in the murine olfactory bulb (OB) modulate the gain of the first synapse in the olfactory chain through the release of GABA and dopamine. They can be cleanly classified into two subtypes with distinct morphological and physiological properties: one axon-bearing and embryonic-born, and one anaxonic and regenerating. These are hypothesised to mediate odour discrimination and sensitivity, respectively, but understanding their distinct contributions to olfactory behaviour relies on knowing the inputs they receive and how they in turn modulate olfactory circuitry.

To understand the landscape of olfactory input to DA neurons, we used rabies tracing to map and reconstruct its presynaptic partners. This revealed cells of variable morphology within each OB layer and in the olfactory cortex, suggesting diverse inputs to DA neurons, including top-down influences.

Patch clamp experiments allowed us to look at these inputs functionally and to separate the two DA subtypes. Axon-bearing DA neurons receive more excitatory inputs, including more from ETCs. While the frequency of inhibitory inputs is the same across both subtypes, the much smaller size of anaxonic neurons means they receive a significantly higher density of inhibitory input and, accordingly, the addition of a GABA blocker appears to be more impactful on their activity than it is for the larger axon-bearing neurons.

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Olfactory substitution by the trigeminal system in humans: a promising therapeutic approach

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Type of abstract: POSTER

Subject area: Multisensory - Behavioral/perceptual

Keywords: smell, trigeminal , stimulation, electrical, therapy, treatment

Introduction: Olfactory dysfunction (OD) affects around one-fifth of the population, which can lead to a diminished quality of life. Limited treatment options and recent advances in technologies such as artificial noses are moving olfactory implants into closer reach. Trigeminal stimulation offers a promising, less invasive strategy targeting neural pathways closely interlinked with the olfactory system. This multicentric study aimed to assess the sensitivity of patients with OD to electrical stimuli and their ability to discriminate between different patterns of stimulation.

Method: The first study compared the electrical intranasal sensitivity in patients with OD (n=54) of different etiologies and healthy individuals (n=28). A second study involving patients with OD (n=52) and healthy individuals (n=13) assessed their ability to detect and discriminate two patterns of electrical stimuli, which were triggered by a coupled electronic nose.

Results: The first study revealed a preserved trigeminal function for the majority of patients with OD. The second study showed that >70% of the patients were able to discriminate between two stimulation patterns. However, 100% of the participants were able to detect the stimuli.

Discussion: Trigeminal stimulation could be a promising option to substitute the olfactory system in patients with OD.

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Odor exposure modulates pain perception: insights from behavioral and neural evidence

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: Odor exposure, pain threshold, pain tolerance, olfactory, trigeminal, ERP, time-frequency analysis

Objectives

This study examined whether odors that trigger non-painful cooling trigeminal sensations modulate experimentally induced pain, and compared the effects between odors that induce olfactory versus cooling trigeminal sensations.

Methods

Using a within-subject design, we included 30 healthy adults (24.9 ± 4.4 years, 17 women). Participants had a 30-minute odor exposure by wearing a nasal clip filled with one of the three conditions: phenyl ethyl alcohol (PEA), menthol, or an odorless control. After 30 minutes, pain perception was measured using pulsatile electrical stimulation, and electroencephalography (EEG) recordings were taken in response to painful electrical stimuli. The procedure was performed for all three odor conditions in a randomized sequence.

Results

There was a significant odor effect on pain tolerance ($F=5.20$, $p<0.01$), with participants showing higher pain tolerance after exposure to menthol and PEA than control ($t=2.42$ - 3.16 , $p's<0.05$). EEG results showed similar patterns ($F=3.61$ - 6.17 , $p's<0.03$), with significantly smaller event-related potential (ERP) amplitudes for PEA (P2, N1P2) and menthol (N1, P2, N1P2) than control ($t=2.53$ - 3.19 , $p's<0.05$). Time-frequency analysis showed that in the first 500ms in the delta/theta band, both menthol and PEA induced less synchronization than control. Approximately between 400-700ms, only PEA showed significantly more synchronization in the alpha/beta band than control. From around 750-1500ms, all conditions showed desynchronization in the delta band, but PEA had significantly less desynchronization than control.

Conclusions

Short-term exposure to "olfactory" and cooling "trigeminal" odors can reduce pain perception at behavioral levels which is also reflected in brain activity. Menthol and PEA show similar effects but may involve different mechanisms. Menthol might primarily modulate pain in the early stage, while PEA appears to modify processing over a prolonged period of time.

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Impact of genetic polymorphism on TAS1R2/TAS1R3 receptor activation by sweeteners

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Type of abstract: POSTER

Subject area: Taste - Other

Keywords: taste, sweet taste receptor, sugar, sweetener, SNP

The sweet taste receptor, a heterodimer composed of TAS1R2 and TAS1R3 subunits, detects chemically diverse sweet-tasting compounds. Genetic variations in these genes, particularly single-nucleotide polymorphisms (SNPs), have been associated with altered sweet taste perception and metabolic phenotypes. However, their functional consequences on receptor activation remain incompletely characterized. This study evaluates the effect of 28 coding-region SNPs (12 in TAS1R2, 16 in TAS1R3) on receptor activation by 12 structurally diverse sweeteners.

Using calcium mobilization assays with HEK293T cells transiently expressing wild-type or variant of TAS1R2/TAS1R3 receptors, dose-response relationships were quantified (EC_{50} and maximal amplitude). Additionally, 162 DNA samples from overweight/obese individuals were genotyped to identify novel SNPs predicted to alter receptor function.

Our functional assays revealed that I595T and K689Q variants of TAS1R2, as well as L95P, M110T, G367C, S551N, and F749S variants of TAS1R3, significantly reduced receptor activation for several sweeteners. Conversely, R813K and G832R variants of TAS1R3 increased receptor sensitivity to the studied sweeteners. Seven previously unreported SNPs found in the obese cohort were predicted to alter receptor function.

Despite these in vitro functional alterations, no consistent genotype-phenotype association emerged for sweet taste preference or obesity. These results suggest that although specific TAS1R2 and TAS1R3 variants modulate receptor sensitivity, sweet taste perception and sugar intake are multifactorial traits influenced by additional genetic, environmental, and behavioral determinants.

In conclusion, this comprehensive functional analysis elucidates the impact of variants encoding TAS1R2/TAS1R3 on sweet taste receptor activity and highlights the complexity underlying genotype-phenotype relationships in metabolic regulation.

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Odor effects on sleep quality: evaluating odor quality and application methods

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: application, diffuser, Fitbit, olfaction, sleep

Purpose: The role of smell in improving sleep quality is inconclusive. This study aimed to investigate whether the type of odor and the method of application affect sleep quality.

Methods: Based on individual preference 113 healthy participants (mean age $\pm$ SD = 32 ± 12 years, 44 men) selected an odor (lavender, orange, specifically designed “perfume”) and an application method (odorized nasal clips, odors on pillow, odors through diffuser). Their performance was compared to a control group ($n = 19$; mean age $\pm$ SD = 29 ± 6 years, 9 men). Except for the control group, all groups slept with exposure to odor for 2 weeks (phase 1), followed by 2 more weeks of normal sleep without odors (phase 2). The Pittsburgh Sleep Quality Index and the wearable sleep monitoring device “Fitbit Charge 2” were used to measure sleep quality.

Results: After adjusting for baseline differences, participants exposed to “perfume” reported better subjective sleep quality during the odor exposure phase compared to the control group. Among the applications evaluated, the use of a diffuser was associated with better sleep quality and reduced daytime fatigue. No significant group differences were observed in sleep parameters measured by Fitbit.

Conclusion: Exposure to odors during the night influences sleep quality. Using a diffuser to deliver the odor appears to be associated with better subjective sleep quality and reduced daytime fatigue. No sustained improvement in sleep quality over time was observed with odor exposure.

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"Perceived naturalness in perfumery: a cognitive construct"

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Naturalness Natural compound Olfaction Odor perception

In the flavor and fragrance industry, naturality is a key driver of consumer preference, brand positioning, and regulatory strategy. This study explores the perception of olfactory naturalness through a mixed-methods approach combining psychophysics and sensory evaluation. Qualitative data collected from 377 participants allowed for the identification of olfactory families commonly associated with the perception of naturalness. In parallel, quantitative data from subjective evaluations involving over 30 participants from two distinct cultural contexts (French and South Korean) enabled an examination of cultural influences on this perception. This cross-cultural perspective contributes to a deeper understanding of how odors are perceived as "natural," independent of their chemical composition or the presence of visual cues such as labeling. The results will open up promising avenues for future research, particularly into the potential cognitive effects of odors perceived as natural.

Modeling heavy metal-induced taste dysfunction using human iPSC-derived taste bud organoids

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Type of abstract: POSTER

Subject area: Taste - Peripheral processing

Keywords: Taste bud, taste, pollution, lead, cadmium, organoid, human fungiform taste cells

Environmental heavy metals such as lead and cadmium are known to impair taste perception and damage the olfactory system; however, the underlying mechanisms remain poorly understood, largely due to the absence of physiologically relevant human models. We hypothesize that exposure to these pollutants disrupts the function and viability of taste receptor cells, contributing to age-related taste loss and altered dietary behavior. To address this, we will employ a two-pronged strategy: a 2D culture of immortalized human fungiform taste cells, and the development of a novel 3D taste bud organoid model derived from human induced pluripotent stem cells (iPSCs). These complementary systems, coupled with sophisticated exposure setups, will enable us to investigate the cellular and molecular impact of defined concentrations of cadmium and lead under conditions that mimic real-world exposure. We will analyze chemosensory function and cellular integrity by functional assays-including calcium imaging, gene expression profiling (qPCR, RNA-seq), and immunostaining for the key taste receptors TAS1R (sweet/umami), TAS2R (bitter), and mechanoreceptors (PIEZO1/2). Fundamental results demonstrate that heavy metal exposure significantly reduces taste receptor expression and impairs calcium signaling in taste bud organoids, indicating compromised taste transduction^{1,2}. Additional analyses will address the impact on mechanoreceptor function and taste cell subtype differentiation. By integrating these molecular and cellular data, the project aims to clarify the mechanisms through which pollutants impair taste perception, identify the exposure levels at which this occurs, and to establish 2D cells and 3D human organoid models as a relevant platform for chemosensory toxicology research. This work will provide a foundation for understanding pollutant-induced taste dysfunction and inform strategies to mitigate sensory health risks in exposed populations.

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Olfactory function and mental health

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: Olfaction, mental health, wellbeing

Aim of study

The risk of developing depressive symptoms increases with age. The following study aimed to verify if olfactory training, a regular, structured exposure to odors, may relieve symptoms of depression in the older people population.

Methods

Older people participants ($N = 101$, $M_{age} = 72.6$, $SD = 5.44$, 88% women) participated in this study. The experimental group ($N = 50$, $M_{age} = 72.0$, $SD = 5.49$) underwent 12-week olfactory training sniffing twice a day four scented felt-tip pens (so-called the Sniffin' Sticks) containing scent of cloves, scent of rose, scent of eucalyptus, and scent of lemon. Placebo group ($N = 51$, $M_{age} = 73.2$, $SD = 5.37$) was performing the same training regimen with odorless Sniffin' Sticks. Depressive symptoms were measured before and after the training with the Patient Health Questionnaire (PHQ-9), compliant with diagnostic criteria according to the DSM-V.

Results

The analysis did not show a statistically significant effect of olfactory training on depressive symptoms in the overall sample of older individuals. However, we found promising preliminary evidence for the effectiveness of olfactory training to relieve depressive symptoms in the subsample ($N = 20$) of older individuals with baseline moderate depression.

Conclusions

The present investigation offers preliminary evidence that olfactory training is an enjoyable and easy-to-administer intervention in the geriatric population, which further predestines it for psychological effectiveness testing in the older populations, especially clinical groups. These results should be replicated in an extended, targeted geriatric sample with moderate depression.

This work was supported by the National Science Centre grant (OPUS scheme 2020/37/B/HS6/00288) awarded to Anna Oleszkiewicz.

Flavor-flavor and flavor-nutrient conditioning with odors: competition or amplification?

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Type of abstract: POSTER

Subject area: Multisensory - Behavioral/perceptual

Keywords: Odor, Taste, Flavor, Conditioning, Metabolism, Glucose

Imagine you are hungry, and the sweet scent of vanilla draws you in to buy a cake. Two forms of conditioning can explain this behavior: flavor-flavor (FFc) where sweet taste acts as the unconditioned stimulus, and flavor-nutrient (FNc), where associations with postprandial metabolic effects are formed. Whether these two processes amplify, inhibit, or remain independent of each other remains unclear. To answer this question, fasted participants completed two sessions during which FFc of a target odor with sweet taste was implemented and disguised via triangle tests across four blocks of five trials each. Each trial consisted of participants tasting three solutions and indicating whether a cup contained a different flavor or all were the same. Of the five trials (randomized), two were conditioning trials, with three cups of 1. an unfamiliar odor mixed with sucralose (CS+), and 2. another unfamiliar odor mixed with water (CS-). The remaining trials served as distractors and included one odd stimulus among two others (coconut/almond odor, saline, or water). Each block was either preceded by a maltodextrin-based caloric beverage or water (control), depending on the session (FNc). Associative learning and metabolic responses were assessed via odor ratings (wanting, sweetness, liking) and blood glucose measures collected before and after the full conditioning session.

Preliminary results show that both CS+ and CS- odors were rated sweeter and elicited higher wanting during the maltodextrin compared to the water session. However, in the water session only, CS+ ratings increased more than CS- from pre- to post-conditioning, both in sweetness and wanting. These results suggest that FFc and FNc rely on distinct mechanisms, with FNc attenuating or overriding the effects of FFc. This could reflect the involvement of distinct neural processes and highlight wanting dimension in assessing odor memories.

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Sensing Bitterness in the Gut: Bitter Taste Receptors (TAS2Rs) as a key modulators of GLP-1 secretion

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Type of abstract: POSTER

Subject area: Taste - Peripheral processing

Keywords: TAS2R4; TAS2R1; TAS2R14; GLP-1

The physiological functions of bitter taste receptors (TAS2Rs) expressed in the gastrointestinal tract remain incompletely understood. Emerging evidence suggests that TAS2Rs may influence the secretion of gut-derived hormones, including glucagon-like peptide-1 (GLP-1), a key modulator of glucose homeostasis and appetite. We hypothesised that selective activation of specific TAS2Rs modulates GLP-1 secretion, thereby contributing to metabolic regulation.

Using human Hu-Tu80 enteroendocrine cells, we investigated the effects of TAS2R agonists on GLP-1 secretion following prior gene silencing of selected TAS2Rs. Stimulation with costunolide induced a dose-dependent increase in GLP-1 secretion. Silencing TAS2R4 significantly reduced this effect, while TAS2R14 knockdown enhanced secretion at lower doses. Amarogentin-induced GLP-1 release was sensitive to silencing TAS2R4 and TAS2R14. Silencing TAS2R14 increased secretion, whereas TAS2R4 knockdown further diminished it. Additionally, TAS2R1 and TAS2R4 silencing markedly impaired the GLP-1 response to the TAS2R1 agonist KDT501.

Our findings reveal that distinct TAS2Rs exert receptor-specific effects on GLP-1 secretion, with TAS2R4 appearing to play a principal stimulatory role, while others exhibit dose-dependent or inhibitory influences. These results highlight the complexity of TAS2R-mediated signalling in gut hormone regulation and support their potential as novel targets for therapies addressing metabolic disorders such as type 2 diabetes and obesity. Collectively, our data underscore the importance of bitter compound sensing in the gastrointestinal tract as a modulator of endocrine function.

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Human olfactory sensitivity varies across geographical locations

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Biological sciences, Neuroscience, Olfactory system, Olfactory receptors, Psychology, Human behaviour

It has been assumed that olfactory sensitivity is relatively consistent in different populations worldwide. Emerging, yet fragmented, evidence lends credit to the hypothesis that olfactory sensitivity may be ethnically and geographically diverse. To gain deeper insight regarding the interplay between environmental, demographic, and health factors in the context of olfactory sensitivity, we conducted a multicenter study comprising data from 1046 from 19 locations around the world. Our results revealed that location accounted for 17-20% of the variance in chemosensory sensitivity. Demographic and psychological factors related to working memory and depressive symptoms are additionally helpful in explaining sensitivity to odors, accounting for 1.8-2.7% of variance in chemosensory sensitivity. People inhabiting different regions may have different sensitivities to chemical stimuli due to varying exposures to atmospheric conditions and different chemosensory experiences in daily life. We discuss the potential source of ~80% of unexplained variance.

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Olfactory cues evoke more autobiographical memories than visual and auditory stimuli

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Type of abstract: POSTER

Subject area: Multisensory - Behavioral/perceptual

Keywords: Autobiographical memory, Sensory retrieval cues, Olfaction, Emotion, Memory

Odor-evoked autobiographical memories are often described as pleasant, vivid and emotionally rich. However, empirical evidence regarding their distinctiveness compared to other sensory cues remains mixed. This study examined the characteristics of autobiographical memories triggered by naturalistic odors, photographs, and sounds, focusing on their emotionality, vividness, and pleasantness. The final sample in this between-participants design consisted of 106 participants from Türkiye (51 women, 25-45 years, $M=31.90$, $SD=7.49$). In each of the three conditions, participants were presented with cues corresponding to 10 objects in a random order (odors: the actual scented objects, photographs: color images, words: the names of the objects displayed on a computer screen). Following each cue, participants were instructed to recall a personal memory associated with the presented cue. If a memory was successfully retrieved, the subject was asked to write their memory as detailed as possible, and rated the evoked memory based on its experiential characteristics (emotionality, pleasantness, vividness of the memory). Results showed no effect of cue condition on emotionality, pleasantness, or vividness of the recalled memories ($p>.05$). However, a significant main effect of cue type was found for the total number of memories retrieved ($F(2,98) = 3.383$, $p = .038$, $\eta^2p = .065$), with odors eliciting more memories overall compared to the other modalities, although post hoc t-tests did not reach significance after correction for multiple comparisons. The results suggest that odors may serve as more effective cues for retrieving autobiographical memories in terms of quantity, though not in emotional or sensory quality. Previous studies rarely found an advantage for odor cues, and we speculate that our use of complex naturalistic odors may have contributed, which future studies may test directly.

A low-cost olfactometer for simultaneous odour delivery in multi-animal rodent behavioural studies

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Olfactometers are essential tools in chemosensory research, enabling precise temporal and spatial control of odour delivery to study odour-driven behaviour in animals and humans. While sophisticated designs are available, replicating custom setups can be challenging for laboratories with modest budgets and without access to in-house workshops. Commercial systems, though reliable and convenient, often involve high costs, proprietary components, and limited flexibility for customisation or integration with behavioural and recording setups. To address these accessibility barriers, we developed a versatile, cost-effective 4-module (expandable) olfactometer using only commercially available parts and open-source software. Each module has two channels (diluted odorant and solvent alone), with outputs combined and delivered in parallel to four behavioural test chambers – each receiving the same stimulus simultaneously. To ensure equal air flow, only one channel per module is active: for single-odour presentations, one odour bottle and three solvent bottles are opened; for mixtures, selected modules deliver odour while the others deliver solvent. An Arduino microcontroller operates solenoid valves for precise, programmable stimulus delivery. Performance was validated using miniPID recordings across all modules and chambers, confirming consistent temporally controlled odour delivery across all modules at various valve opening times and odour concentrations. Behavioural validation of the olfactometer with mice was achieved using innately attractive or neutral odours. Mouse behaviour was recorded during exposure with inexpensive USB cameras and analysed using open-source tools such as Bonsai and DeepLabCut. Analyses revealed mice show clear preference for opposite sex urine over solvent controls and spent more time investigation odour ports during active odour delivery, validating both the technical performance and biological relevance of the system.

Spatial distribution and characterization of olfactory and respiratory epithelium in aging human nasal tissue

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: 3D-reconstruction, epithelial metaplasia, aging olfactory system, immunohistochemistry

It is well established that the olfactory epithelium (OE) regresses throughout human life and undergoes metaplasia into respiratory epithelium (RE). To further investigate this process, several human nasal cavities were decalcified using EDTA solution, cryosectioned, and analyzed via immunohistochemistry. A multiplexing approach was established to maximize information from each section, enabling multiple rounds of antibody staining on the same cryosection. Using this method, both OE and RE were characterized in detail.

Based on the cryosection data, a 3D model was reconstructed to visualize the nasal cavity and the spacial distribution of the two epithelia. The analysis revealed extensive areas lacking clear markers for either OE or RE such as OMP, CALB2, CD56 or AcTUB. These regions may represent transitional epithelium that is gradually replaced by RE over time, or permanent aneuronal zones of the OE. In addition, the surface area occupied by OE showed a large interindividual variability.

These findings contribute to a better understanding of epithelial remodeling in the aging human olfactory system and may serve as a foundation and inspiration for further investigations into the structure of the olfactory epithelium and the cause of its metaplastic transformation into respiratory epithelium.

All funding was granted by the University of Tuebingen.

Analysis of chemosensory function in mice using a novel contact-based stimulus delivery device

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: vomeronasal, behavior, olfactory, urine, stimulus delivery

Like many other organisms, mice rely on their olfactory system to obtain critical information about their animate and non-animate environment. The vomeronasal system (VNS) plays a key role in processing cues from other organisms. One of its defining features is the mode of stimulus uptake, which requires physical contact with the substrate for efficient stimulus sampling. This feature allows the VNS to detect non-volatile molecules, which do not efficiently activate the main olfactory system. Thus, to systematically investigate VNS dependent behavioral abilities, and ongoing neuronal activity during stimulus processing, an effective way to deliver stimuli to behaving animals is needed. To address this need, we recently developed the liquid stimulus delivery system (LSDS), designed to deliver fluid natural secretions to awake head-fixed mice using direct nasal contact. Here, we used this system to test chemosensory discrimination of urine from two conspecific strains. We characterized performance as a function of stimulus dilution, contact vs. no contact delivery mode, and for distinct urinary fractions containing high and low molecular weight components. At this stage, our analyses indicate that mice can successfully discriminate urine samples using all urine fractions, both with and without nasal contact. These results suggest that the mice can utilize diverse cues to discriminate among strains, and that more challenging behavioral tasks may be required to identify sensory abilities that strictly rely on vomeronasal system activation.

Integrating biological and psychophysical knowledge into Machine Learning models for predicting human scent perception

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: scent perception; machine learning; domain-informed neural networks; odor character; odor intensity

This project aims to develop biologically informed artificial intelligence models that integrate molecular, psychophysical, and receptor-level data to predict human scent perception. The main objective is to establish robust correlations between a scent's perceptual attributes, namely its character and intensity, its molecular structure, and olfactory receptors activation patterns. The central hypothesis suggests that both qualitative (character) and quantitative (intensity) are mediated by the same olfactory receptors, suggesting a unified biological mechanism underlying human olfactory experience. The methodology involves four main stages. First, large, structured datasets are compiled and harmonized from both public and commercial sources, containing molecular descriptors, perceptual ratings, and experimentally validated receptor interaction data. Next, data curation includes ontology mapping to align the diverse scent vocabularies used across datasets. Chemometric analysis is applied to extract latent variable structures and improve data conditioning. Two parallel AI modeling approaches are pursued. In the first, graph neural networks are trained on receptor interaction profiles and physicochemical properties encoded in graph form. In the second, transformer-based sequence models are developed using augmented molecular strings such as SMILES and SELFIES. These models are pre-trained unsupervised on large datasets, then fine-tuned with supervised learning to predict perceptual labels, including scent character and intensity. This study highlights the potential of integrating biological and psychophysical insights into AI to model olfaction. Preliminary results support the hypothesis that incorporating available olfactory receptor data and psychophysical information in model pretraining improves predictive accuracy for both character and intensity. These models contribute to fundamental sensory science and practical applications in fragrance design and innovation.

c-Kit signaling confers damage-resistance to sweet taste cells upon nerve injury

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Type of abstract: POSTER

Subject area: Taste - Peripheral processing

Keywords: Taste, taste buds, denervation, nerve injury, regeneration, c-Kit

Taste buds relay taste sensory information to the primary taste neurons but depend on those same neurons for essential components to maintain function. While denervation-induced taste bud degeneration and subsequent regeneration were discovered decades ago, the mechanisms underlying these phenomena (e.g., heterogenous cellular responses to nerve injury and the signaling pathways involved) remain poorly understood. Here, using mouse genetics, nerve injury models, pharmacologic manipulation, and taste bud organoid models, we identify a specific subpopulation of taste cells, predominantly c-Kit-expressing sweet cells, that exhibit superior resistance to nerve injury. We found the c-Kit inhibitor imatinib selectively reduced the number of residual c-Kit-expressing sweet cells at post-operation week 2, subsequently attenuating the re-emergence of other type II cells by post-operation week 4. In taste bud organoids, c-Kit-expressing cells were resistant to R-spondin withdrawal but susceptible to imatinib, while other taste cell types showed the opposite behavior. We also observed a distinct population of residual taste cells that acquired stem-like properties, generating clonal descendent cells among suprabasal keratinocytes independent of c-Kit signaling. Together, our findings reveal that c-Kit signaling confers resilience on c-Kit-expressing sweet cells and supports the broader reconstruction of taste buds during the later regenerative stage following nerve injury.

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Establishment of Taste Bud Organoids from Anterior Lingual Mucosa

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Type of abstract: POSTER

Subject area: Taste - Other

Keywords: Taste, Taste bud, organoid

Excessive salt intake is a major risk factor for various modern diseases. Salt perception is regulated by taste cells within taste buds, particularly those responsive to salty stimuli located in the fungiform papillae (FuP) of the anterior tongue. However, their limited number has made molecular and cellular analysis difficult. While many in vivo studies on taste have been conducted, suitable in vitro models remain scarce. Although organoid technology has been applied to mimic taste buds, all existing taste bud organoids have been derived from circumvallate papillae (CVP) in the posterior tongue. No model has been reported that recapitulates FuP-specific taste cells. Here, we successfully established culture conditions to generate anterior tongue-derived taste bud organoids (aTBOs) containing all major taste cell types. This represents the first in vitro model that mimics FuP taste cell biology. Our platform provides a valuable tool to investigate the mechanisms of salty taste perception and may contribute to developing strategies for regulating salt intake.

Whole-Brain Encoding of Opposite-Sex Odors in Mice

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Olfaction, Sexual Odors, Behaviors, Light Sheet.

Sexual imprinting is a form of learned mate preference in which individuals develop attraction (positive) or avoidance (negative) to traits observed during their early social environment¹. These preferences, shape adult mate choice and promote pairing with partners likely to provide high-quality parental care². In rodents, olfaction is the major sensory modality and plays an important role in regulating social behaviors, particularly in mate selection³. Here, we performed whole-brain analyses of females reared with and without their fathers and then exposed to familiar (father-exposed) and unfamiliar (novel) olfactory stimuli. We also measured females' behavior during stimulus exposure, to correlate brain activation with behavioral performance. Additionally, for generalisation and ecological validation, we compared whole-brain activation and behavior in C57BL/6j laboratory females with wild house mice. Neuronal activity was measured using whole-brain immunolabeling for the immediate early gene c-Fos. Brains were cleared using the iDISCO protocol and imaged by light-sheet fluorescence microscopy. We used ClearMap for single-cell detection and brain atlas registration. Our results show clear differences between laboratory and wild mice in both recruited brain areas and behavior. Laboratory mice actively interact with stimuli, whereas wild mice have less interaction with stimuli, with increased contact to familiar compared to novel odor cues. Differences in behavior correlate with differences in brain activation. Although we see an overall overlap in macro-regions between experimental groups, wild mice show less activation compared to laboratory mice, and specific recruitment of different subregions. Brain activation correlates well with differences in behavioral performance between laboratory and wild mice highlighting different specific strategies for odor-driven social decision-making and providing insight into the neural basis of learned mate preferences.

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Mucus-on-chip: Yeast-based model to study olfactory mucus effect on odor reception

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: Olfaction, mucus-on-chip, olfactory mucus, viscosity, viscoelasticity, yeast biosensor, Differential Dynamic Microscopy, aroma diffusion, mucins, humanized yeast, biomimetic mucus

Odor perception relies on detecting volatile molecules via olfactory receptors (ORs) in the nasal cavity, which are covered by a 10–15 μm olfactory mucus (OM) layer. OM has a lower periciliary aqueous phase and an upper, more viscous gel phase rich in mucins. It is composed of water, mucins, ions, proteins, immunoglobulins and lipids. Goblet cells secrete mucus into the periciliary layer, which then moves into the gel phase, trapping odorants and aiding their interaction with ORs. While ORs are well-studied, how the aroma compounds interact with the mucus is unclear. Organ-on-chip advances allow in vitro models that can mimic organ functions, offering a new way to study the role in odor detection. Our study aims to develop a microfluidic system that closely mimics the human nasal cavity, using engineered yeast biosensor cells expressing human ORs. These humanized yeast cells, which emit fluorescence when activated, will be immobilized within a microfluidic 'mucus-on-chip' model. To create a realistic assay, we are developing biomimetic OM as real mucus use is impractical. Using Differential Dynamic Microscopy, we characterized for the first time the viscoelastic properties of the two OM phases. Our pilot study (four donors) found that at 1Hz, the gel phase has an average viscosity of 3 Pa·s while the aqueous phase has 0.09 Pa·s, inconsistent with reported nasal fluid viscosities. We found that polyethylene oxide mimics the shear-thinning properties of natural mucus, exhibiting increasing viscosity as the concentration increases. However, the elasticity is not comparable to real OM, likely due to crosslinking between mucin molecules. We are optimising artificial mucus by adding salts, fucose, lipids, and exploring crosslinking polymers. This model will help us to study how pH, temperature, ions, sugars, and lipids impact mucus viscosity and aroma diffusion, as well as understand how genetic and compositional differences in mucus and receptors impact odor detection.

References

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Olfactory training using nasal inserts is more effective due to increased adherence

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: hyposmia, olfactory disorder, olfactory training, smell, treatment adherence

The recommended treatment for hyposmia (a clinically reduced sense of smell) is olfactory training using odor containers that the patients smell twice a day for several weeks. Adherence to the olfactory training regimen is, however, generally low. We aimed to investigate if a new form of odor delivery, using scented nasal inserts, could enhance adherence to olfactory training by allowing participants to be mobile during the training and thereby lower the perceived intrusion on everyday life. Using a randomized controlled parallel-group design, individuals (N = 116) with hyposmia underwent 8 weeks of olfactory training. One group was assigned olfactory training using scented nasal inserts (nasal devices that retain nasal patency) while the other group was assigned the standard care regimen currently recommended by the Swedish healthcare system. We assessed objective and subjective olfactory ability before and after olfactory training as well as adherence to training. Both groups significantly improved both their objective and subjective olfactory abilities, and training with nasal inserts produced similar improvement as standard care in overall treatment outcome. However, there was a significantly greater increase in discrimination performance and lower dropout rate (6.7%) in the nasal insert compared to the standard care group (23.2%). Critically, after exclusion of the drop-out participants, the nasal insert group still showed significantly higher adherence to the training regimen. Olfactory training with nasal inserts could serve as a more effective form of treatment for hyposmia due to patients' improved adherence to protocol and increased tendency to finish their treatment regimen.

Receptor responses to pure odorants in *Drosophila melanogaster* olfactory receptors

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Type of abstract: POSTER

Subject area: Olfaction - Peripheral processing

Keywords: odor response profiles, stimulus concentration, calcium imaging, gas chromatography

Olfactory coding relies on primary information from olfactory receptor cells, that respond to volatile airborne substances. Despite of extensive efforts, our understanding of odor-response profiles across receptors is still poor, due to the vast number of possible ligands (odorants), the high sensitivity even to trace compounds (creating false positive responses), and the diversity of olfactory receptors. Here, we linked chemical purification with a gas chromatograph to single-receptor type recording with transgenic flies using calcium imaging to record olfactory responses to a large panel of chemicals in 7 *Drosophila* ORs: Or10a, Or13a, Or22a, Or42b, Or47a, Or56a, Or92a. We analyze the data using linear-non-linear modeling, and reveal that most receptors have “simple” response types (mostly positive: Or10a, Or13a, Or22a, Or47a, Or56a). However, two receptors (Or42b, Or92a) have, in addition to “simple” responses, “complex” response types to some ligands, either positive with a negative second phase, or negative with a positive second phase, suggesting the presence of multiple binding sites and/or transduction cascades. We show that some ligands reported in the literature are false positives, due to contaminations in the stimulus. We recorded all stimuli across concentrations, showing that at different concentrations different substances appear as best ligands. Our data show that studying combinatorial olfactory coding must consider temporal response properties and odorant concentration, and in addition is strongly influenced by the presence of trace amounts of ligands (contaminations) in the samples. These observations have important repercussions for our thinking about how animals navigate their olfactory environment.

Safeguarding olfactory and flavor heritage amid climate change: the SCENTINEL Project in Brazil

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Type of abstract: POSTER

Subject area: Multisensory - Other

Keywords: Climate change; intangible cultural heritage; safeguard; smell and flavour heritage;

The SCENTINEL Project aims to preserve and digitize scents and flavors of living cultural and historical significance that are under threat due to climate change. Recognizing the vital role of chemosensory experiences in shaping identity and heritage, the project seeks to identify, evaluate, protect, and reproduce olfactory and taste elements integral to human cultural practices. To identify intangible sensorial heritage at risk, the project combined extensive literature reviews with in-depth interviews conducted with community leaders and cultural practitioners. These qualitative methods informed the selection of four Brazilian cultural expressions as case studies: Lavagem do Bonfim (Washing of the Bonfim Church), Baianas do Acarajé (Street Food of Bahia), the Festival of Yemanjá, and elements of Yorubá culture. Fieldwork included the capture of volatile organic compounds (VOCs) using headspace sampling techniques, including Tenax tubes and solid-phase microextraction (SPME) fibers.

Preliminary VOC data were successfully collected from each cultural setting. Samples are currently undergoing laboratory analysis to identify key scent compounds. These results will inform the formulation of synthetic reproductions and enable digital encoding of the olfactory and flavor profiles. Machine learning techniques are being developed to assist in both scent and flavors classification and digital preservation. The SCENTINEL Project demonstrates a multidisciplinary and community-based approach to safeguarding sensorial heritage. It highlights how olfactory, and flavors elements can be documented and preserved through scientific and digital methods. Moreover, the project underscores the impact of chemoreception on cultural identity and community cohesion, offering a novel perspective within sensory research.

Building a shared digital infrastructure for olfactory research: the Hub4Smell initiative

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Olfaction, digital tools, sensory science infrastructure, collaborative research

Hub4Smell is a novel digital infrastructure developed to advance olfactory science by providing standardized, scalable tools for human smell data collection, integration, and analysis. Although olfaction is increasingly recognized as critical to health and behavior, the widespread implementation of olfactory assessment and data-driven research remains constrained by the absence of validated, accessible methodologies and interoperable data systems.

Hub4Smell addresses these limitations through a customizable suite of tools for data collection, curation, and analysis, built on principles of open science and incorporating recent advances in conversational analytics. A secure online environment fosters methodological exchange, expert consultation, and multi-site study coordination. The platform was developed through collaboration among academic researchers, digital health developers, and medical device experts, and aligns with national public health priorities outlined in the NIDCD 2023–2027 Strategic Plan and Healthy People 2030.

To assess its utility, we analyzed a dataset from $N = 400$ adults, with and without olfactory dysfunction, who completed four validated olfactory tests (Sniffin' Sticks Identification, NIH Toolbox Odor Identification, BSIT, and SCENTinel® test) and visual analog scales assessing smell-related attributes (e.g., perceived odor intensity). Results demonstrate Hub4Smell's capacity to integrate heterogeneous datasets across test types and participant characteristics.

These findings illustrate the platform's potential to support reproducible olfactory phenotyping and enable comparative analyses across diverse populations and measures, thereby facilitating scalable, translational chemosensory research.

References

¹ NIDCD (grant #R44DC021198).

Temporal discrimination by sensory and projection neurons of the accessory and main olfactory bulbs

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: olfaction, main olfactory bulb, accessory olfactory bulb, vomeronasal system, temporal dynamics

Olfaction relies on temporal patterns of neural activity to encode information about odor stimuli. In mammals, the main olfactory bulb (MOB) and accessory olfactory bulb (AOB) are key brain regions involved in early olfactory processing. While the ability of the main olfactory system to encode fine temporal features has been previously demonstrated, the vomeronasal system is traditionally viewed as less involved in such discrimination. Our research investigated the capacity of mice to detect subtle changes in the timing of optogenetic stimulation delivered to the MOB or AOB. We focused on four types of temporal manipulations: pulse frequency (different pulse length and rate), pulse duration (different pulse length, same rate), inter-pulse intervals (different gap between fixed-length pulses), and timing relative to the breathing phase. Experiments were conducted in behaving, head-fixed transgenic mice using a modified lick/no-lick two-alternative forced choice paradigm. We optogenetically activated mitral/tufted cells or olfactory sensory neurons and compared behavioral responses following MOB and AOB stimulation. Both systems exhibited robust discrimination when mitral/tufted cells were activated, with mice distinguishing pulse duration differences as small as 15 ms and inter-pulse interval differences of 60 ms. In contrast, with sensory neuron activation, mice could still discriminate 15 ms pulse duration differences, but failed to detect even 170 ms inter-pulse interval gaps. Notably, the vomeronasal system showed discrimination abilities comparable to those of the main olfactory system across tasks, indicating that both systems can reliably encode temporal features of sensory input.

References

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Stimulus-dependent modulation in mouse olfactory signal transduction

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Type of abstract: POSTER

Subject area: Olfaction - Peripheral processing

Keywords: Olfaction, transduction, olfactory receptors, patch-clamp electrophysiology, mouse, OSN

Short-term sensory adaptation to prolonged or repetitive stimuli is essential for maintaining dynamic sensitivity in sensory systems. In olfactory sensory neurons (OSNs), odorant receptor activation triggers a G-protein-mediated cAMP cascade, which is counterbalanced by Ca^{2+} /calmodulin-dependent negative feedback. Many olfactory receptors and, thus, OSNs are highly sensitive, allowing detection across odor concentrations that span several orders of magnitude. Beyond adaptation, it remains unclear whether additional dose-dependent modulatory mechanisms influence OSN sensitivity.

Here, we use patch-clamp recordings from OSNs in acute slices to assess how varying interstimulus intervals and stimulus intensities modulate action potential generation, thereby influencing olfactory signal transmission to the brain. We aim to dissect (i) which components of the signaling cascade are critical key players in modulation, (ii) whether dose-dependent modulation is receptor-dependent, and (iii) whether response modulation arises with the maturation of OSNs. Together, we seek to gain insight into how OSNs fine-tune their sensitivity and responsiveness to encode a wide range of odorant concentrations.

Multiple routes to olfactory cortex

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Type of abstract: POSTER

Subject area: Multisensory - Central processing

Neuroimaging research has shown that both primary and secondary olfactory areas can be activated via top-down imagery and via cross-modal stimuli associated with olfaction. However, it is unclear how similar olfactory representations are when olfactory stimuli are directly presented as compared to when the olfactory network is activated by olfactory imagery or via cross-modal connections. We aimed to explore overlap in olfactory neural representation when olfactory information is received via vision or via olfactory imagery in comparison to bottom-up olfactory input. The study had a final sample of 22 female and 3 male participants ($M_{\text{age}} = 28.48, \pm 6.03$ years). In the first fMRI session participants viewed pictures of olfactory associated and non-olfactory associated objects (picture task) followed by an olfactory imagery task. Objects evoking pleasant and unpleasant odours were used. Nineteen participants then completed an olfactory fMRI session where phenethyl alcohol (rose) and hydrogen sulphide (rotten egg) were presented using a computer-controlled olfactometer. MVPA will be used to compare activation patterns across tasks in the following regions: piriform cortex (PC), amygdala (AMY), hippocampus (HPC), insula (INS), and the orbitofrontal cortex (OFC). Preliminary cluster-level corrected whole brain analysis shows activation of key nodes in the olfactory network (PC, AMY, INS, and OFC) in response to olfactory associated pictures when compared to non-olfactory associated pictures. These initial findings suggest that early olfactory regions may process olfactory information from visual sources. Overall, this work will highlight how olfactory information is represented in the brain when received through alternative sensory and cognitive domains as opposed to bottom-up sensory stimulation.

Tropisms of adeno-associated viruses in projection neurons of the mouse olfactory bulb

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Type of abstract: POSTER

Subject area: Olfaction - Central processing

Keywords: Olfaction, Main olfactory bulb, AAVs

The main olfactory bulb integrates sensory input from neurons in the main olfactory epithelium and relays information to downstream targets via two projection neuron populations, i.e., mitral and tufted cells. Although these neuronal cell types play a crucial role in olfactory processing, we still lack tools to selectively target either neuron type.

Due to their efficient gene delivery, low cytotoxicity, and versatility, recombinant adeno-associated viruses (rAAVs) have emerged as reliable tools for circuit mapping, functional modulation of neuronal activity and various other aspects of neuroscientific research. However, achieving cell type-specific transduction with rAAVs depends on various factors such as viral volume, titer, serotype and promotor. Here, we sought to identify the rAAV variants most suitable for studying mitral and/or tufted cells of the main olfactory bulb. We systematically evaluated the transduction patterns of different anterograde rAAV virus constructs and serotypes after performing stereotactic MOB injections in transgenic Tbx21-Cre mice, which grant genetic access to olfactory bulb projection neurons.

Our results show that apart from the rAAV serotype, other genomic design factors – especially the promotor sequence – play a crucial role in the cell type specific tropism of the virus.

Astringent compounds target $G\alpha_q$ protein-coupled receptors and the calcium release-activated Orai channels in the human tongue cell line HSC-3

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Type of abstract: POSTER

Subject area: Taste - Peripheral processing

Keywords: Astringency, Bitterness, GPCRs, Orai channels

Astringency is a poorly understood dry and rough sensation in the mouth after consuming polyphenol-rich beverages and is often experienced in conjunction with bitterness. Although there are several theories on how astringency might be perceived, there is still no clear evidence if and which G protein-coupled receptors (GPCRs) are involved.^{1,2} We hypothesize that a GPCR coupled to $G\alpha_q$ plays a role in astringency in distinction to bitterness, in which the $G\alpha_i$ type is involved. We also propose that calcium release-activated Orai channels play a role in the lingering perception of astringency by amplifying the transient Ca^{2+} signal of GPCRs through an influx of Ca^{2+} . To investigate this, we applied the astringent compound tannic acid (TA), the astringent and bitter compound epigallocatechin gallate (EGCG) and the bitter tasting quinine to the human tongue HSC-3 cell line, as a widely established surrogate model for investigating astringency,^{3,4} in Ca^{2+} and cAMP signaling assays. We detected Ca^{2+} signals for TA ($EC_{50} = 11 \mu M$), EGCG ($EC_{50} = 330 \mu M$) and quinine ($EC_{50} = 1.49 mM$), but only for TA and EGCG a reduction completely to the baseline ($p < 0.0001$) with the $G\alpha_q$ inhibitor FR900359 and not for quinine. Additionally, a reduction in the signal with the Orai inhibitor Syntha66 for EGCG and TA was detected but not for quinine. Knock down experiments to verify their participation are currently underway. Furthermore, we also showed that EGCG ($IC_{50} = 360 \mu M$), TA ($IC_{50} = 53 \mu M$) and quinine ($IC_{50} = 720 \mu M$) target GPCRs with a $G\alpha_i$ activity by reducing the cAMP levels, which is verified with the $G\alpha_i$ inhibitor pertussis toxin. In summary, these results indicate that astringency might be perceived via $G\alpha_q$ protein-coupled receptors and the lingering effect results from the participation of OraIs. We also showed that TA, EGCG and quinine stimulate bitter signaling pathways, a result that aligns with sensory studies, as astringent compounds are commonly perceived as bitter as well.

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Modulating the modulators: chemogenetic dissection of bulbar dopaminergic contributions to olfactory behaviour.

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Olfactory bulb; Dopaminergic neurons; DREADD; Odour-based behavioural tasks

Dopaminergic neurons have been identified as a distinct class of interneurons within the olfactory bulb (OB), with the majority having the capacity for regeneration throughout life. Although dopamine is known to influence smell-related behaviours, the specific functional contributions of OB dopaminergic neurons to processes such as odour detection and discrimination remain poorly understood. Existing hypotheses about their behavioural roles often lack anatomical specificity, with results potentially confounded by dopaminergic activity from the midbrain and further complicated by the diversity of behavioural assays used, leading to inconsistent findings.

In this study conducted on mice, we used immunohistochemistry to confirm that the number of tyrosine hydroxylase (TH)-expressing neurons in the OB remains stable across life stage. We also quantified their proportion relative to all neurons in the glomerular layer, labelled with NeuroTrace which, unlike DAPI, selectively stains neuronal nuclei. To assess the causal role of this stable but non-dominant DA population, we stereotactically injected pAAV-hSyn-DIO-hM4D(Gi)-mCherry into the OB of adult dopamine transporter (DAT)-Cre mice, thus targeting exclusively bulbar DA neurons. One month later to allow DREADD expression, we administered clozapine-N-oxide (CNO) intraperitoneally to transiently inhibit these infected DA neurons and evaluated performance across olfactory tasks. These included odour habituation, discrimination, and responses to aversive and appetitive stimuli. Using a custom behavioural setup and associated olfactometer, we measured time spent near the odour port and overall locomotion. Preliminary data suggest that modulating the activity of dopaminergic neurons increases behavioural sensitivity to certain odours.

This work lays the groundwork for unravelling the functional significance of the dopaminergic interneuron population within the OB and their specific contributions to odour-guided behaviour.

References

¹ BBSRC Grant

Olfactory-evoked reliving of autobiographical memories: music as a comparative modality

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: autobiographical memory, odor-evoked memory, reliving, immersion, GEQ scores

Objectives of the study:

This study investigates the sense of reliving the past evoked by olfactory cues, which are closely linked to emotion and autobiographical memory. Music was used for comparison. The focus is on immersive recall as a component of reliving and how the two modalities differ in evoking it.

Experimental methods used:

Fifty-one university students (mean age = 22.14) were randomly assigned to an odor group ($n = 26$) or a music group ($n = 25$). After completing questionnaires on sensory traits, participants were exposed to 15 odor or music stimuli and rated how strongly each evoked autobiographical memories. The stimulus that received the highest rating was chosen for a 3-minute oral memory report. They then rated the memory on reliving, vividness, emotional intensity, pleasantness, and the age at the event. Five items from the Game Experience Questionnaire (GEQ) were also used to assess immersive recall.

Essential results:

Odors evoked a sense of being brought back to the past ($M = 3.81$, $SD = 1.13$), comparable to music ($M = 3.96$, $SD = 0.86$), likely because the most evocative stimulus was selected. Odor-evoked memories also showed high GEQ scores ($M = 12.04$, $SD = 3.50$), though not significantly different from music ($M = 13.33$, $SD = 4.27$). For the item "Time seems to kind of stand still or stop", music scored slightly higher ($p = .078$). Fewer events were recalled in the odor group ($M = 1.32$, $SD = 0.63$) than in the music group ($M = 1.92$, $SD = 0.97$; $p = .015$). However, the amount of reported content did not differ, suggesting odors may evoke more detailed descriptions per event.

Conclusions:

Olfactory cues can evoke immersive memory experiences comparable to those triggered by music. Moreover, odor-evoked memories tended to contain richer details, underscoring the distinctive potential of olfaction as a cue for autobiographical recall.

Identification of sources of funding:

This study received no external funding.

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A cake surprise to further investigate the recently discovered visual food stream

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: neuroimaging food visual system

Perception forms a crucial source of information for the control of behavior. The human brain has a category-selective organization to recognize and discriminate between different kinds of especially salient types of visual information, like faces, scenes, words and bodies. A specialization area for food, a primary reinforcer and salient category for behavior, has been suspected (van der Laan et al, 2011), but was only recently confirmed by data-driven methods in three studies of neural responses to a large variety of natural scenes in photos (Jain et al., 2023a; Khosla et al., 2022; Pennock et al., 2023). Food object selective responses were observed in the ventral visual stream in the fusiform cortex. Illusions are an important instrument in the behavioral neuroscientist's toolkit (Eagleman, 2001). Illusions that use perceptual switches between categories allow for the dissociation of category selective responses (Tong et al., 1998). Here we used a dynamic food-object illusion to characterize perceptual and neural responses to foods in the ventral visual stream, with hyper realistic cakes. In "hyper realistic cake videos" artists convincingly disguise a cake as a non-edible object, which is revealed after slicing into the object. In a behavioral study we showed that participants ($n = 18$) find the hyper-realistic cakes surprising ($F(1,14.64) = 23.786$, $p < .001$) and more edible than control videos ($F(1,17.01) = 39.457$, $p < .001$). Data collection in the fMRI study is ongoing ($n = 15$). Preliminary analyses comparing the hyperrealistic cake after the knife cut (relative to before and relative to control videos) indicate that the cake videos evoke a response in the fusiform gyrus (left, 219 voxels, $z = 4.45$, $p_{FWE} = .003$, right, 347 voxels, $z = 4.24$, $p_{FWE} < .001$). Our results suggest that the illusion is successful in providing a perceptual switch and response in the visual food stream.

References

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Altered maturation of doublecortin neurons in the olfactory cortex, olfactory tubercle and paralaminar amygdala in Fmr1-KO and Mecp2-KO mice

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Type of abstract: POSTER

Subject area: Olfaction – Development

Keywords: Rett syndrome, Fragile X syndrome, postnatal neurogenesis, olfaction, piriform cortex, amygdala, olfactory tubercle

Rett syndrome (RTT) and Fragile X syndrome (FXS) are rare neurodevelopmental disorders, affecting mainly females and males, respectively. Patients affected by these syndromes exhibit intellectual disability, motor impairment, autistic features and altered sensory processing, including olfactory deficits. These disorders are caused by loss of function mutations in the X-linked genes MECP2 and FMR1, which are involved in neural maturation. Immature neurons located in the olfactory cortex and paralaminar nucleus of the amygdala are generated during embryonic development and undergo slow postnatal maturation, with sharp decrease during the pubescent period. We hypothesised that deficiency in either Mecp2 or Fmr1 would impair the postnatal maturation trajectories of these neurons. To test this, we performed immunofluorescent detection of doublecortin, a marker of immaturity, in coronal brain sections from infantile, adolescent, and young adult Mecp2-KO, Fmr1-KO and WT mice. In addition, we combined this marker with NeuN, a marker of neuronal maturity, and Ki67, an intrinsic proliferation marker. Our data show that the density of doublecortin neurons and their co-expression with NeuN vary depending on genotype, age and sex, with an excess of doublecortin neurons at specific timepoints in both types of mutants. In addition, we analysed doublecortin-expressing neurons in the olfactory tubercle, where we also observed increased density of immature neurons. Altogether, our results support a key role of Fmr1 and Mecp2 in the protracted maturation of doublecortin-expressing neurons in olfactory regions and suggest that their deficit could contribute to olfactory dysfunction in patients. Funded by the Conselleria de Educació, Universidades y Empleo from the Generalitat Valenciana (CIAICO/2023/027, CIPROM/2023/053) and FinRett 2022.

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¹ CIAICO/2023/027, CIPROM/2023/053

² FinRett 2022

CALRETININ-POSITIVE INTERNEURONS ARE ABUNDANT IN THE CHEMOSENSORY AMYGDALA AND MIGHT BE ALTERED IN MECP2-KO MICE

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Amygdala; calretinin; Rett syndrom; vomeronasal system

The amygdala is involved in a wide range of behavioural functions essential for survival, including social interactions and olfactory processing, thanks to their direct inputs from the main and accessory olfactory bulbs (OB). In the OB, there is an abundant population of calretinin-positive (CR+) interneurons, and the olfactory pathway is enriched in CR. However, the distribution of CR+ neurons in the chemosensory nuclei of the amygdala, i.e. cortical and medial, remains poorly studied. In this work, we investigated the distribution of CR-immunoreactivity in the amygdala of mice. To do so, we performed an immunohistochemical staining for CR in WT male mice and *Mecp2*-KO, model of Rett syndrome, a rare neurodevelopmental disorder causing autistic features and olfactory dysfunction. We found that CR is expressed throughout the amygdala, with different density of both fibres and somata among nuclei. In particular, the density of CR+ somata is higher in the medial and cortical amygdala as compared to the lateral and basolateral nuclei, and scarce in the central amygdala. In addition, we observed two groups of CR+ interneurons in caudal levels with high expression of CR near to the amygdalopiriform transition area, posterolateral cortical amygdaloid nucleus and posteromedial cortical amygdaloid nucleus. On the other hand, one study showed a higher density of CR+ neocortical interneurons in *Mecp2*-KO, so we focused on further investigating the density of these interneurons in the posteromedial cortical amygdala to see if the results are consistent and the possible effects in the Rett syndrome model. Future research should investigate the implication of CR interneurons in the chemosensory amygdala in the atypical social and olfactory behaviours displayed by *Mecp2*-KO mice. Funded by the Conselleria de Educació, Universitats y Empleo from the Generalitat Valenciana (CIAICO/2023/027, CIAICO/2023/041) and FinRett 2022.

References

¹ CIAICO/2023/027, CIAICO/2023/041

² FinRett 2022

Effects of olfactory stimuli on the recognition of facial expressions in individuals with depressive symptoms: an event-related potential EEG study

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Type of abstract: POSTER

Subject area: Olfaction - Central processing

In everyday settings, perception is inherently multisensory, with congruent cues from different sensory modalities often working together to enhance object recognition. Among these senses, olfaction holds a unique connection to emotion and has been shown to influence the perception of emotional stimuli in other modalities. For instance, odors can bias the interpretation of emotional facial expressions, typically shifting perceived valence in line with the odor's affective tone. Altered olfactory abilities have been linked to many mental health conditions, including depression, though findings on how individuals with depressive symptoms perceive pleasant and unpleasant odors are mixed. Notably, it also remains unclear how people with depressive symptoms integrate emotional information across modalities, such as odors and facial expressions. While individuals with major depression struggle in recognizing happy, disgusted, and neutral faces, the role of olfactory input in shaping this process has not yet been explored. In this pre-registered study, during EEG recording, participants are shown facial expressions of fear or happiness, morphed with neutral expressions along a linear continuum, to create subtle emotional cues. Each image is paired with a pleasant (lavender) or unpleasant (isovaleric acid) odor. Participants then categorize the emotion of the face and rate its intensity. The study is underway, with a planned sample of 108 participants divided into depressive symptoms and healthy control groups. Behavioral (emotion categorization accuracy; reaction times) and event-related potential measures of early (N1/P1; N170) and late (P3; LPP) processing will be analysed. Understanding how olfactory stimuli affect the recognition of emotional facial expressions in people with depressive symptoms, along with the related neural mechanisms of multisensory integration, will deepen our knowledge of the olfactory context's role in shaping emotional processing in depression.

Sensory Evaluation of Effervescent Nutritional Supplements: Identification and Characterisation of Off-Tastes

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Sensory analysis, Effervescent nutritional supplements, Cross-modal interactions, Bitterness masking, Flavor perception

Effervescent nutritional supplements, while offering advantages such as improved bioavailability and ease of ingestion, often suffer from poor sensory qualities due to the presence of vitamins, minerals, and amino acids known for their bitter, astringent, and metallic tastes. This study aimed to systematically evaluate and characterize the sensory profiles of four effervescent formulations using a trained panel and quantitative descriptive analysis (QDA). Sensory attributes were assessed across three perception modalities: orthonasal smell, retronasal aroma during tasting, and aftertaste. Products differed significantly in both aromatic and gustatory dimensions. Bitterness, metallic sensation, and astringency were identified as major negative attributes, particularly in products enriched with specific minerals. Flavouring agents showed differential effects on sensory perception, where fruity and citrus notes often enhanced sweetness and masked unpleasant tastes via cross-modal interactions. Blocking retronasal airflow using nose clips confirmed that these odour-induced effects notably influenced sweetness and reduced bitterness and astringency. However, in some cases, flavouring also unexpectedly intensified metallic sensations. The results highlight the complex interplay between taste and aroma perception in these products and underscore the need for tailored flavour strategies. Understanding these interactions opens promising avenues for improving consumer acceptance of nutritional supplements through reduced reliance on additives or encapsulation, thereby enhancing both palatability and nutritional alignment.

This research was funded by Bayer Healthcare SAS and ANRT (National Agency for Research and Technology, France).

Activity-dependent plasticity in the mouse olfactory bulb: effects of prolonged enrichment

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Type of abstract: POSTER

Subject area: Olfaction - Peripheral processing

Keywords: Olfactory Bulb, Plasticity, Axon Initial Segment

Activity-dependent plasticity has been well-described in the various cell types of the murine olfactory bulb (OB) as it adapts to prolonged changes in odour space. These changes span the bulb, from modulation of the input from the olfactory sensory neuron (OSN), to modulation of activity, synaptic strength, intrinsic excitability, and structure of the principal mitral and tufted cells (M/TCs) and inhibitory dopaminergic (DA) interneuron populations. However, much of this picture comes from the case of prolonged olfactory deprivation, and little is known about plasticity under its inverse, olfactory enrichment.

Here, we describe a robust passive olfactory enrichment protocol in which adult mice of either sex were exposed to a panel of eight monomolecular odorants in their individually-ventilated home cage for durations spanning from a day to a week. Immunohistochemical analysis and confocal microscopy confirmed that the odorant panel was broad enough to activate the OB glomerular map in a non-spatially clustered manner, allowing for random sampling.

By comparing enriched mice to control littermates, we compared changes in OSN input in OB glomeruli using vesicular glutamate transporter type 2 (VGlut2) staining intensity and proportional labelling. In M/TCs and dopaminergic interneurons, activity level was explored by comparing staining intensity of immediate early gene cFos, with further confirmation in DA cells by measuring tyrosine hydroxylase (TH) fluorescence. Finally, Ankyrin G (axon initial segment (AIS) protein) staining in M/TCs and DA cells allowed for 3D tracing of the AIS, a marker of structural plasticity which is closely linked to intrinsic excitability.

Preliminary analysis indicates a structural plasticity phenotype in the AISes of DA interneurons. This analysis suggests an asymmetrical manifestation of plasticity compared to olfactory deprivation, thus prompting a reconsideration of how bidirectional homeostatic plasticity operates in sensory systems.

The limited capacity of olfactory working memory

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: olfaction, working memory

Working memory (WM) is a core cognitive function that enables the temporary maintenance of information, but its capacity is inherently limited. In three experiments, we examined the capacity limits of olfactory WM using three memory paradigms: the delayed match-to-sample task, Sternberg's paradigm and N-back task. The first and second experiments investigated whether a single odor could be retained in WM over different delay periods. On each trial, an odorant (item) was presented, followed by another odorant (probe) after one of three delays (6s, 12s, 24s). Although recognition performance declined with increasing delay, it remained significantly above chance, demonstrating that humans can maintain an odor object representation in short-term memory. Experiment 2 employed Sternberg's paradigm to assess the capacity limits. Participants studied arrays of 1, 2, or 4 odorants and then judged whether a subsequent probe matched any item in the set. Using Cowan's K to measure capacity quantitatively, we found that the capacity of olfactory WM is limited to approximately 2-3 odor objects. Finally, the third experiment employed 2-back task to probe the ability to manipulate these items held in WM. Despite the added executive demands, participants can update and manipulate information in WM. Taken together, these results demonstrate that, although olfactory WM capacity is smaller than that reported for vision or audition, humans nonetheless can maintain and manipulate multiple odor object representations in WM.

References

¹ Funded by ERC

Beyond odorants: a fragment-based approach to discover ligands for human odorant receptors

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: odorant receptors deorphanization fragment based screening

The majority of human odorant receptors (ORs) remain orphan, with no known activating ligands. Functional screenings to deorphanize ORs typically rely on odorants—volatile, low molecular weight molecules naturally associated with smell perception. Although odorants are chemically diverse, many ORs remain orphan even after extensive testing. Some of these receptors are also expressed ectopically, which may mean that their preferred ligands could include endogenous molecules that are not like traditional odorants. In this context, we explored an alternative approach using chemical molecular fragments—small synthetic compounds, some of which are structurally inspired by natural products (“natural-like”), but that are not necessarily volatile and are typically used for drug screenings. We screened two curated libraries containing 4,480 such fragments against two variants of a selected human OR, using a heterologous expression system coupled to a cAMP-dependent luciferase reporter assay. Our results show that multiple fragments elicited receptor activation, demonstrating that synthetic chemical fragments can engage human ORs and serve as a complementary strategy for ligand discovery. This approach expands the chemical space beyond traditional odorants and may help uncover novel ligands for ORs that remain unresponsive in standard odorant-based assays.

Sweetness preference in a multi-lab global population: a replication study

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: taste perception, sweet liking, individual differences, sugar intake

High free sugar intake contributes to the global epidemic of obesity and related metabolic disorders, which may be mediated by a higher sweetness preference. A solution to mitigate these risks is to reduce the amount of added sugar in foods; however, this may compromise their overall acceptability. More research is needed into the variation and flexibility in sweetness preferences. In 2011 Mennella et al. developed a fast psychophysical test (the Monell Forced-Choice Paired-Comparison, MPC) to assess an individual's sucrose preference. They showed that sweet preference is related to the sugar content of preferred and frequently consumed foods and beverages. However, whether these results generalize beyond an urban United States (US) population is unclear. We conducted a large-scale global data collection to replicate and extend those observations. Methods: i) the MPC to measure sweetness preference, ii) a survey to assess the liking and intake frequency of foods, iii) available global data on consumption of sugar-sweetened beverages, and iv) preferences for commercial sweetened beverages. Data were collected from 989 women and 777 men across 31 laboratories in 20 countries, including laboratories in Africa, Asia, Europe, North America, Oceania, and South America (data collection ongoing). Preliminary analyses show a similar reliability of the MPC as in the study of Mennella, 2011 (intraclass correlation = 0.56). An average (m) sucrose preference of 12.5 %w/v (standard deviation, sd: 8.2) was observed in the MPC. We observed a significant effect of self-reported sex at birth; women (m=11.2, sd=8.1) prefer lower concentrations of sucrose than men (m=14.2, sd=8.9) ($F(1,1764) = 53.09, p < .001$). These preliminary results show that our global sample of women prefers a lower concentration of sucrose relative to the US women in the original study by Mennella et al. (m=14.4, sd=10.4), and also relative to a global sample of men.

References

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Identification of novel TAS2R4 agonists by screening of a natural compound library

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Type of abstract: POSTER

Subject area: Taste - Other

The NatPure compound library, one of the largest collections of pure natural compounds, comprises around 15,000 molecules from diverse plant and microbial origins. It's chemical diversity and the fact that about 30% of its compounds are novel and unpublished, makes it a unique resource for drug discovery and taste research. The present study illustrates a screening campaign to identify novel TAS2R4 ligands and identified new compounds from different classes activating TAS2R4. Interestingly, some of the newly identified compounds do not contribute to bitterness perception. This result supports different TAS2R4 signaling properties and may suggest physiological effects in disparate organs in which the receptor is expressed. This opens new research avenues for understanding the broader physiological roles of taste receptors and the therapeutic potential of these non-bitter agonists in both pharmaceutical applications and in the food industry.

Effects of cognitive behavioral therapy on the perception and worry of own body odor in Olfactory Reference Disorder

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Body odor, Olfactory reference Disorder, Clinical

Olfactory reference disorder (ORD; a new disorder in ICD-11) is characterized by a strong belief in emitting an unpleasant body odor from one's body, such as armpits, mouth or genitalia. This condition is stressful and associated with an increased risk of suicide, but no treatment guidelines are available. We first conducted a pilot study evaluating the feasibility and preliminary efficacy of internet-based cognitive behavioral therapy (iCBT), which indicated promising results: symptom reduction in ORD with a large effect size (>2.0), and 80% of participants achieving at least a 30% decrease in symptom severity. Notably, 47% of participants no longer met diagnostic criteria for ORD at post-treatment. Patient satisfaction was high and no serious adverse events were reported, supporting the feasibility of the intervention.

Based on these findings, we have now launched a preregistered randomized controlled trial (RCT, $n=60$) evaluating 10 weeks of iCBT for ORD. The study will also examine which types of body odors that are most common in ORD reports and also to what extent the self-perception of own body odor or rather worry for smelling bad is the largest problem to this group. As part of the pilot study, we also collected body odor pads from the ORD and control participants which will be perceptually evaluated by a separate group of participants ($n=30$) to reveal whether there actually are any differences in body odor between ORD and controls.

Funding: Swedish Research Council (Swedish Research Council: 2020-02567 to MO)

References

¹ Funding: Swedish Research Council (Swedish Research Council: 2020-02567 to MO)

Adolescents aged 12-18 years score similarly in the Sniffin' Sticks Screening 12 Test and U-Sniff tests.

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: adolescents, olfaction, smell, Sniffin' Sticks Screening 12 Test, U-Sniff tests

Objectives: The epidemiology of olfactory disorders in the pediatric and adolescent population is not well defined, primarily due to underreporting, the lack of routine olfactory testing in children, and the tendency of young children to not recognize or articulate olfactory deficits. Testing children requires standardized, validated olfactory tests specific to this age group. However, dedicated tests are not always available in diagnostics and the age of the patient may allow to adopt tests designed for adults. The study aimed to evaluate the Sniffin' Sticks Screening 12 Test scores applied in an adolescent population (but designed for adults) and compare them with the scores in the U-Sniff test designed for children.

Methods: A group of 85 children aged 12-18 years (Mean=15,7, SD=2,1; 41 men) were examined using two olfactory identification tests the Sniffin' Sticks Screening 12 Test and the U-Sniff test. In addition, the subjects completed the Individual Significance of Olfaction Questionnaire (the question about kissing a partner was omitted) and the Sense of Smell Importance Questionnaire in the areas of eating, forming bonds, and avoiding danger.

Results: Within the U-Sniff test, the smell of butter was the most difficult, obtaining 41.2% of correct answers. The other smells ranged from 63-98%. For the Sniffin' Sticks Screening 12 Test, only two items scored lower at 60 and 62.4% for leather and pineapple, respectively. There were no gender differences in odor identification performance. No significant correlation emerged between odor identification test results and questionnaire responses.

Conclusions: The use of the the Sniffin' Sticks Screening 12 Test and Test U-Sniff in the adolescent population can be used interchangeably, with attention to single items in both tests.

Funding: This research was funded by Wrocław Medical University SUBZ.C250.24.088.

Smell and Taste Distortions in U.S. Adults: Prevalence and Risk Factors during the COVID-19 Pandemic

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Type of abstract: POSTER

Subject area: Multisensory - Behavioral/perceptual

Keywords: smell, taste, distortion, prevalence, risk factor, COVID-19

Background: Phantosmia or parosmia and parageusia or dysgeusia are sensory distortions that can lower quality of life and impair eating, sleeping, and emotional well-being.

Methods: The 2021 National Health Interview Survey (NHIS) included questions about smell and taste from 29,482 U.S. adults (≥ 18 years). We estimated the prevalence of distortions of smell and taste and their associations with COVID-19 and other risk factors. Estimates were adjusted for the complex random sampling design and logistic regression was used after adjusting for age, sex, race/ethnicity, education, income, and geographic area.

Results: A history of COVID-19 was reported by 14.2%. Prevalence of altered sensation was 19.7% for smell and 13.3% for taste. Altered sensation occurred more frequently among those with COVID-19 (50.7% and 41.3%, for smell and taste, respectively). Distortions of smell and taste were reported by 4.7% and 2.9% overall, and by 12.4% and 7.6% among those with COVID-19. Prevalences increased greatly with COVID-19 symptom severity for smell (3.1% to 19.7%) and taste (2.7% to 15.5%), from no symptoms to severe symptoms. Prevalences peaked among those with partial recovery of smell (30.2%) or taste (29.2%). Smell and taste distortions were more frequent with female sex, lower income, cigarette smoking, poorer health, obesity, recent cold/flu, asthma, dry mouth, hypertension, depression/anxiety, medication use, immunosuppression, and cognitive decline. Among adults aged ≥ 40 years with distortions of smell and taste, 20.6% and 38.6%, respectively, reported discussing their symptoms with a health care provider; proportions were higher among those with COVID-19 (37.3% and 52.9%).

Conclusions: Smell and taste distortions were prevalent among adults, particularly those with COVID-19, poorer health, and certain demographic factors. Findings highlight the need for greater clinical attention and research on assessment, management, co-morbidities, and prevention.

The importance of smell and its functions in humans: a comparison with other senses and other activity domains in France

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Since Antiquity and Aristotle's hierarchy, olfaction has been considered as the least important sense, a belief reinforced by centuries of philosophical and scientific discourse in various fields. In recent decades, this assumption has been challenged by research into the significance of olfaction. The present study aims to clarify the role of olfaction in daily life by comparing its perceived value to other sensory modalities and common life commodities. An online study was conducted in 130 normosmic respondents in France (97 women, 33 men, aged 18-79), measuring willingness to lose each sense and ranking the importance of chemical senses to a range of everyday items (e.g. salary, living space, social media, streaming platforms, smoke detectors, perfume, travel, sports, car, phone, pets, friends, hair and little toe). Results confirm the dominance of distal senses over proximal ones ($p < 0.001$). This result may be explained by the values of Western societies, where vision and hearing are culturally associated with anticipation, and knowledge acquisition. Olfaction ranks in the middle of the sensory hierarchy due to its position as both a proximal and distal sense. Yet, its functions, particularly those linked to food, social communication, and danger avoidance, are valued more than several commodities ($p < 0.05$ in all cases) but are ranked equally to affective terms (friends, pets), body parts (hair, toe) and leisure (travel, sports). Among olfactory functions, food-related seems most important, followed by those supporting social and protective roles. These findings suggest olfaction hold a more significant role in daily life than traditionally assumed, despite persistent visual dominance. Our next steps will examine how culture and individual olfactory profile (e.g. patients or experts) influence these valuations. This study is a part of Typhaine de Simone's PhD project, funded by an ANRT CIFRE research program between Université Claude Bernard Lyon 1 and MANE.

Central olfactory responses to odor repetition on the seconds timescale

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Type of abstract: POSTER

Subject area: Olfaction - Central processing

Keywords: olfaction, adaptation, olfactory bulb, piriform cortex, extracellular recordings

Olfactory cues in natural environments exhibit wide concentration ranges and dynamic temporal patterning, requiring neural processes to adjust according to recent stimulus history to optimize sensitivity. Short timescale stimulus repetition elicits decreased responses in olfactory receptor neurons (i.e., adaptation), and central olfactory responses in OB and PCx are reduced after prolonged stimulus exposure.

Though peripheral and central adaptation have been studied extensively in reduced and anesthetized preparations, observations in the intact, awake brain remain rare. This gap constrains our ability to link the perceptual and behavioral consequences of repeated odor exposure to their underlying neural mechanisms. To characterize responses to odor stimulus repetition, we acquired neural population recordings from OB (n = 563 units) and PCx (n = 1128 units) of awake, head-fixed mice responding to odor pulses with varying interpulse intervals (IPIs: 2, 4, 8, 16, 32 s). We selected odors to overlap with previous work on ORN and OB adaptation in awake mice (Storace & Cohen, 2021). First pulse responses exhibited odor sensitivity consistent with previous reports (~10-20% of cells in both regions responding with activation or suppression). Second pulse responses in both regions exhibited adaptation at 2 s (OB: 16.2%; PCx: 7.5% of cells) that gradually recovered over the next 30 s, with greater overall adaptation and steeper recovery in OB.

Surprisingly, second pulse responses at short intervals significantly increased for a substantial subset of neurons in both regions (OB: 11%; PCx: 9% of cells at 2 s). Our results reveal that, unlike the predominantly suppressive responses of ORNs, central circuits exhibit both adaptation and facilitation, suggesting an active rebalancing of network output. This reorganization may support computations that track temporal structure in odor signals while preserving dynamic range.

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Niemann-Pick type C1 mouse models show impaired lipid profile and microglia activation

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Type of abstract: POSTER

Subject area: Olfaction - Peripheral processing

Keywords: Peripheral olfactory system, Npc1, neurodegeneration, cholesterol, neuroinflammation, microglia

Niemann-Pick type C1 (Npc1) is a rare neurodegenerative disorder linked to altered cholesterol biosynthesis and irregular lipid regulation. In patients, the most common variant in the Npc1 is a missense mutation (I1061T) that leads to a faulty Npc1 protein and consequently to cholesterol accumulation in lysosomes and its impaired synthesis and metabolism. We tried to better understand what happens to the olfactory system in a mouse model bearing the most common missense mutation found in human patients, namely the Npc1 (I1061T) mouse model. Our preliminary data show that neurodegeneration in the olfactory epithelium (OE) becomes dramatic at two months of age and involves mainly mature OSNs while leaving intact the regenerative ability of stem cell niches in the OE. In addition, we performed positive ion MALDI-TOF MS analysis and found that phosphatidylcholine (PC) 36:4 and 38:4 and PC/LPC ratio increase in mutant mice (MUT) in OE after only one month of age, while negative ion analysis showed an increase in phosphoinositol (PI) and a decrease in sphingomyelin (SM) 16:0 and phosphatidic acid (PA) 34:1 in MUT at two months of age. Since LPC alterations levels and PC/LPC ratio are key markers in neuronal damage and microglia-mediated inflammatory response, we then investigated the neuroinflammation and microglia state. We found that MUT mice present impaired macrophages activation, morphology and localization in the olfactory epithelium (OE) after only one month of age. We noticed an abundant number of phagocytic cups in MUT which are very different from the ramified phagocytes in wild-type mice. It is possible that the intrinsic ability of microglial cells to migrate and actively phagocytose is affected by the lack of Npc1 and the lysosomal accumulation of cholesterol. Our results demonstrate that cholesterol dysmetabolism and neuroinflammation in Npc1 disorder are remarkable pathological hallmarks that exacerbate the progression of neuronal dysfunction.

References

¹ Regional funding

Taste and smell disorders in U.S. adults: prevalence, risk factors, and associations with health care

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Type of abstract: POSTER

Subject area: Multisensory - Other

Keywords: Taste disorders, smell disorders, prevalence, risk factors, health care, dysgeusia, hypogeusia, hypergeusia, hyposmia

Background: Taste and smell disorders are common, associated with aging, socio-economic factors, and poorer health conditions that impact negatively on overall quality of life.

Methods: In the U.S. National Health and Nutrition Examination Survey (NHANES), 2011-2014, taste and smell questions were administered to adults aged 40+ years ($n=7,413$; mean age=58 years; females, 53%). In 2013-2014, an 8-item odor identification test and taste assessment using the generalized Labeled Magnitude Scale (gLMS) to rate whole mouth and tongue tip perceived intensities of bitter and salt solutions was added ($n=3,219$). Hypogeusia and hypergeusia were defined by cut points for 10th and 90th percentiles for younger adults, aged 40-44 years. Dysgeusia was the report of unwanted persistent tastes in the mouth during the past year. Hyposmia was defined by low odor identification scores. Associations between taste or smell disorders with risk factors and health care use were examined using survey weighted logistic regression.

Results: Prevalences of any smell problem, any taste problem, and dysgeusia were 22.3%, 14.9%, and 5.3%, respectively. Women were more likely to have dysgeusia and hypergeusia and less likely to have hypogeusia compared to men ($p<0.01$). Dysgeusia was associated with Hispanic ethnicity, less education, obesity, smoking, hypertension, diabetes, arthritis, asthma, cancer, persistent cold/flu, dry mouth, nasal congestion, and frequent sinus or ear infections. Dysgeusia decreased from 11.2% to 2.4% for reported poor vs. excellent oral health, while hypogeusia increased from 13.8% to 17.7% (both $p<0.05$). Dysgeusia was associated with frequent aching in the mouth (18.6%) vs. never (3.1%). Individuals with taste disorders (hypogeusia or dysgeusia) were more likely to seek health care compared to those with smell disorders.

Conclusions: Understanding differences in modifiable factors is key to preventing chemosensory disorders and improving their clinical management.

Flexible intramolecular disulfide bonding strategies in mammalian odorant receptors

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Type of abstract: POSTER

Subject area: Olfaction - Peripheral processing

Keywords: Odorant receptor, disulfide bond, extra cellular loop, N-terminal region,

Mammals detect a vast array of odorant molecules via odorant receptors (ORs), a large subfamily of G protein-coupled receptors (GPCRs). In many GPCRs, intramolecular disulfide bonds between or within extracellular domains are critical for proper structural formation. However, certain GPCRs, including some ORs, lack one of the conserved cysteine residues in extracellular loop 2 (ECL2), leaving the role of these bonds unclear. Here, we reveal the functional importance of a unique cysteine residue in the N-terminal region of an OR that compensates for the missing ECL2 cysteine and modulates receptor expression and activity. In ORs lacking the conserved ECL2 cysteine, a cysteine in the N-terminal domain may form an alternative disulfide bond, as observed in OR51E2, the only native mammalian OR with an experimentally determined structure¹. We demonstrate that the N-terminal cysteine in OR51E2 is essential for full ligand-induced responsiveness in heterologous cells. Moreover, per-residue confidence scores from AlphaFold for cysteine mutants of ORs correlate with both surface expression and receptor function, suggesting the role of alternative disulfide bond-mediated structural stabilization. We propose that ORs, and potentially other GPCRs, utilize flexible disulfide bonding strategies involving extracellular cysteines, including those in the N-terminus, to achieve proper folding and function.

This work was supported by JSPS-KAKENHI, JST ACT-X, Program on Open Innovation Platform with Enterprises, Research Institute and Academia, and JST SPRING.

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Habituation to saltiness in unimodal and crossmodal perceptions.

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Type of abstract: POSTER

Subject area: Multisensory - Behavioral/perceptual

Keywords: adaptation, taste, odor, human, flavor

We investigated whether saltiness perception decreases with repeated exposure to a salty stimulus, a phenomenon referred to as sensory habituation. If habituation occurs, it might promote higher salt intake to compensate for taste attenuation. Secondly, we assessed whether a congruent aroma—smoky bacon—could attenuate this habituation.

The experiment was initially designed for EEG; however, only the sensory results are presented here. Stimulations were delivered via a gustometer on the extended tongue and saltiness was rated on a vertical continuous scale from “very low” to “very high.” in the course of the blocks. The protocol consisted of three blocks: **1**) participants received short pulses (500 ms) of 2% NaCl every 2.5 s, repeated 40 times, embedded in water pulses to reduce somatosensory artifacts. The sequence was repeated five times, with 1-minute breaks; **2**) they received pulses of 1% NaCl during 20.4 s; and had to held the solution in mouth for another 10 s. This was repeated 20 times (1-minute intervals); **3**) same as Block 2, but with 0.03% smoky bacon aroma added.

In **Block 1**, a slight but significant saltiness habituation occurred (-0.71 ± 0.20 units on a 10-point scale; $z < -5.13$, $p < 0.001$), sustained across trials despite recovery periods. In **Block 3** compared to **Block 2**, the addition of the smoky bacon resulted in a strong increase in initial saltiness perception compared to the salt-only condition ($+2.71 \pm 0.39$ units). However, stronger habituation was found in the crossmodal condition compared to unimodal (-1.32 ± 0.36 units; $z < -6.56$, $p < 0.001$).

Saltiness perception habituates over short repeated exposures. The addition of a congruent aroma amplifies initial saltiness but also accelerates habituation, suggesting that olfactory habituation may be more pronounced than gustatory. This raises considerations for aroma-based salt-reduction strategies.

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Smell, self, and sustenance: exploring sensory and emotional correlates of deviant eating behavior

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: olfactory perception, eating behavior, disordered eating, food relationship, sensory imagery, body image

Previous research has shown lowered olfactory functions and odor discrimination in individuals with eating disorders. However, little is known about people with deviant eating behavior (DEB), a potential subclinical precursor to eating disorders. This study, part of a larger project, investigates the association between individual differences in eating behavior and self-reported food relationships, olfactory perception, sensory imagery, and body image.

This cross-sectional, mixed-methods study uses continuous measures of eating behavior patterns to explore links with scores from other questionnaires. Now, 97 participants completed an online survey assessing their sensitivity to food-related disgust (FDS), body perception (BISS), olfactory awareness (OAS-6), vividness of sensory imagery (Psi-Q), and eating behavior patterns (TFEQ-18).

We hypothesize that individuals' higher emotional scores on scales will indicate more extreme patterns of eating behavior. We expect DEB participants to have higher scores on the Food Disgust Scale while having lower scores on the Positive Eating Scale. It is also expected that they will have lower scores on both the Odor Awareness Scale and the Body Image State Scale, suggesting lowered smell perception and greater body dissatisfaction, respectively, due to reduced engagement with sensory input and elevated body concerns, as commonly reported in people with disordered eating tendencies. We also predict higher scores on the emotional eating, uncontrolled eating, and cognitive restraint subscales of the Three Factor Eating Questionnaire among DEB participants, as these measurements reflect regulatory and cognitive control strategies that are often reinforced in disordered eating cases.

We expect the findings to shed light on sensory factors involved in DEB reflected in an emotional relationship with food, odors processing, imagery, and the associations they evoke.

Funding: Starting grant from Radboud University granted to Dr. Ilja Croijmans

References

¹ Funding: Starting grant from Radboud University granted to Dr. Ilja Croijmans

Micoprism-based two-photon imaging allows in vivo monitoring of mouse AOB mitral cell activity

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: AOB Mitral cells, Two-Photon Microscopy, Calcium Imaging, in vivo

In mammals, the accessory olfactory system is essential for pheromone detection and processing, thus controlling innate behaviors. The accessory olfactory bulb (AOB) is the system's first central processing structure, receiving sensory input from vomeronasal neurons and relaying information to higher brain areas, including amygdala and hypothalamus. AOB mitral cells (AMCs) are the sole projection neurons of the AOB. Their activity is shaped by a complex network of local interneurons. Previous studies in acute slices have shown that AMCs exhibit spontaneous infra-slow oscillatory activity and form microcircuits within the AOB network. However, in vivo investigation of AMC population activity has proved challenging. Here, we present a novel approach to perform network-scale Ca^{2+} imaging of AMCs using two-photon microscopy. We selectively label AMCs with genetically encoded Ca^{2+} indicators of the GCaMP family. Next, inserting a micoprism into the frontal cortex of anaesthetized mice enables AMC recordings. Thus, we characterize spontaneous AMC firing patterns in vivo. We describe kinetics of AMC Ca^{2+} transients and compare these data to previous studies in acute slices. Together, we show that micoprism-based two-photon imaging allows for robust in vivo imaging of AMC population activity and provides the basis for future in vivo investigation of the mouse AOB circuitry.

The role of age-related white matter lesions in odor identification

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Type of abstract: POSTER

Subject area: Olfaction - Central processing

Keywords: Olfaction, Neuroimaging, Aging

White matter lesions (WML) as a biomarker of cerebrovascular damage are known to increase with age affecting the integrity of white matter (WM) projections; however, the contribution of age-related WML in the brain to olfactory functioning remains uncertain. We aimed to determine how baseline levels WML mediate the association between age and WM fibers' neurodegeneration at five years follow-up. Also, we studied the interaction between baseline age-related WML volumes and follow-up WM fibers' neurodegeneration in the prediction of odor identification performance. A sample of 370 adults from the general population (mean age 62.4; 49.1% men), from the Swedish Betula cohort were tested at baseline with 178 individuals also tested at five years follow-up. Participants underwent odor identification testing and magnetic resonance imaging including T1-weighted-3D for WML volume, and Diffusion Tensor Imaging for WM fiber integrity. Mediation and interaction models were used to test our hypothesis. Baseline WML were a significant mediator when predicting follow-up WM integrity, showing that older age association with increased WML volumes partially predicted poorer WM integrity at follow-up. Age-related WML and their interaction with WM integrity significantly predicted odor identification performance at follow-up, showing that individuals with greater baseline WML volumes and poorer WM integrity performed significantly worse compared to those with average or lower WML. These preliminary data show complex associations WML and odor identification performance, highlighting the potential of olfactory testing as an early and accessible marker of underlying cerebrovascular damage in the general population. WML volume are an important contributor to aging trajectories, underscoring the demand of preventive strategies over cerebrovascular risk factors in the aging population. Future analyses focused on location-dependent impact of WML on olfactory function are needed.

Automated in vitro platform for the development of repellents targeting insect olfactory receptors

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Type of abstract: POSTER

Subject area: Olfaction - Development

Keywords: Insect olfactory receptor ; Repellent ; Automated electrophysiological technique ; In vitro test

In recent decades, insects carrying emerging diseases have been spreading throughout the world. The tiger mosquito -*Aedes albopictus* - is a prime example. Thanks to his environmental adaptability, it has spread from Asian forest to tropical regions. Uses of repellent is one of the main public strategies to avoid mosquito's bites. DEET is a synthetic powerful repellent largely use, however it's toxicity combined with first signs of resistance from mosquitos are a cause for concern. Natural alternatives like essential oils are emerging on the market but have shown limited effectiveness over time. New healthy, efficient and friendly environmental natural compounds are desired to fight against this threat.

In the screening pipeline of compounds, primary screening methods of compounds prior to test on mosquitoes are being sought. We initiated the development of an in vitro platform based on automated electrophysiological recordings and insect olfactory receptors targeted by repellents. Using this method, we identified one olfactory receptor as a general target of standard and innovative repellents and performed quantitative assessment of compound efficacy.

Odor induced autobiographical memories: AI based recognition of facial expressions

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Odor, Autobiographical memory, Facial expression recognition. Machine learning

This study examined how olfactory stimuli affect the recall of autobiographical memories and the accompanying facial expressions. Perfumes were used as a means to elicit odor-related memories. Seventy young and healthy participants (age: 24.41, 70 women) selected their two most familiar perfumes from a set of sixteen commercially available perfumes and described related personal memories. Their facial expressions during memory recall were recorded and analyzed using a deep learning-based system combining YOLOv8 for face detection and ResNet-18 for emotion classification. Participants also completed questionnaires regarding their memories and rated the familiarity of each perfume. The results showed that perfume familiarity and the frequency with which a perfume was chosen to induce a memory varied significantly across perfumes. Among the eight classified facial expressions, "neutral" was most common, especially in the high familiarity group. "Fearful" expressions were more often related to more negative memories. Findings suggested that familiar odors induced more stable facial responses. On the other hand, less familiar perfumes or more negative memories are related to more varied facial expressions. Overall, this study indicates the potential of integrating the automated analyses of facial expressions into explorations of odor-induced memories.

Unveiling the Harderian Gland in Rabbits: Morphological, Histochemical, and Immunohistochemical Characterization of a Specialized Orbital Structure

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Type of abstract: POSTER

Subject area: Olfaction - Other

Keywords: Harderian Gland Pheromones Neuroanatomy Exocrine glands Chemical communication

This study presents a comprehensive morphological, histochemical, and immunohistochemical analysis of the Harderian gland in rabbits (*Oryctolagus cuniculus*), a prominent orbital gland implicated in ocular protection and chemical communication. Located within the orbit, this gland plays a key role in the production of lipid- and porphyrin-rich secretions, which are believed to contribute to grooming, photoprotection, and potentially to chemosensory signaling. Despite its anatomical relevance and suggested physiological importance, the Harderian gland remains poorly characterized in lagomorphs, especially regarding its tissue organization and biochemical features.

To address this gap, we conducted a detailed histological investigation of the Harderian gland in adult rabbits of both sexes. Histochemical labeling with selected lectins was employed to examine the distribution of glycoconjugates, while immunohistochemical analysis targeted markers associated with epithelial specialization and secretory function. Our results reveal a complex glandular architecture with distinct regional variation in epithelial morphology and glycan expression patterns. Immunoreactivity profiles further support the presence of functional compartmentalization, suggesting a high degree of specialization in secretory activity.

These findings contribute to a better understanding of the structural and biochemical complexity of the Harderian gland in rabbits, highlighting its potential role in species-specific physiological and behavioral processes. This foundational work opens the path for future research on the gland's endocrine regulation, its possible involvement in chemical communication, and its response to environmental or hormonal changes.

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The Vomeronasal System of *Talpa occidentalis*: A Combined Histological, Immunohistochemical, and Lectin-Binding Approach

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Vomeronasal system Pheromones Neuroanatomy Mole Chemical communication

The vomeronasal system (VNS) is critical for detecting pheromonal cues that modulate sociosexual behaviors. Despite its central role in chemical communication, our understanding of its anatomical and functional variability across mammals remains incomplete. This study provides the first detailed characterization of the VNS in the Iberian mole (*Talpa occidentalis*), a fossorial species endemic to the Iberian Peninsula. We performed a morphofunctional and neurochemical analysis of the vomeronasal organ (VNO) and the accessory olfactory bulb (AOB) using histology, immunohistochemistry, and lectin histochemistry. The VNO in *T. occidentalis* exhibited an unusual circular lumen lined by a uniform sensory epithelium, lacking the dual epithelial organization seen in most species. The vomeronasal cartilage was limited in extent and did not form the typical J-shaped structure. Importantly, no evidence of a vomeronasal pump was found, suggesting alternative mechanisms for semiochemical entry, likely facilitated by the organ's anatomical position and continuous receptor distribution. Immunohistochemical analysis revealed strong expression of Gαi2 and GY8 in sensory neurons, with weaker Gα0 expression, suggesting predominance of V1R-type signal transduction. The AOB, though small, exhibited clear lamination and specific marker localization (Gαi2, OMP, CR, MAP2), indicating robust functional organization. Lectin binding revealed specific glycosylation patterns in the glomerular layer, with STL and LEA marking synaptic regions. These findings uncover unprecedented anatomical and molecular features in the VNS of *T. occidentalis*, positioning this species as a valuable model for studying vomeronasal diversity and evolution among Laurasiatherian mammals.

Odor Awareness Scale in Children (OAS-C) - a novel method to measure odor awareness in preschool children

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: human olfaction, odor awareness, scale validation, children

People differ in their ability to pick up odors from the environment consciously, their awareness of ambient odors, and the role scents play in their lives, all reflected in a metacognitive ability called odor awareness. These differences can be observed rather early, in infants and children, e.g. girls report higher attention and reactivity to odors in daily settings than boys. Yet, research on odor awareness in children, particularly regarding metacognitive olfactory abilities, is limited. The existing methods display good psychometric characteristic, however they require advanced verbal and cognitive abilities, and abstract thinking. High cognitive demand makes available odor awareness measures difficult to use in children. We aimed to validate Odor Awareness Scale in Children (OAS-C) – an open-ended task where children spontaneously list odors they know from daily life. In the pilot study, 34 children aged 6 years (21 girls) were interviewed with our new tool and Children's Olfactory Behavior in Everyday Life (COBEL) questionnaire, to measure convergent validity. Children's olfactory performance was measured with an odor identification U-Sniff test. We also measured food neophobia to assess divergent validity, and verbal fluency, since they can affect odor identification skills and could potentially influence the ability to answer the odor awareness-oriented questions. In the overall sample, our tool trended a positive correlation with COBEL ($r=0.31$, $p=0.095$), and significantly correlated with verbal fluency ($r=0.42$, $p=0.020$). As expected, neither OAS-C nor COBEL correlated with food neophobia ($p>.220$). The new method might serve as a quick and useful tool for measuring odor awareness in preschool children. Upon more extensive validation, OAS-C can provide useful insights into children's olfactory environment and shed light on how children learn about ambient odors. This work was supported by University of Wrocław, with an IDUB program grant awarded to MR.

Study of olfactory behavior in *Drosophila* adults using optogenetic tools

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Olfaction, olfactory behavior, optogenetics, olfactory reception, neural-glia interaction, *Drosophila melanogaster*

Optogenetics allows the alteration of cell activity using genetically targeted expression of light activated receptors as channelrhodopsin or halorhodopsin. Thus, by expressing these receptors in different cells of the behavioral circuit, it is possible to evaluate their effect on the final behavior. With this approach the native behavioral stimulus is replaced by the light-induced electrical activation of different points of the circuit and its effects on subsequent steps of the circuit or on the final behavior can be analyzed.

In this work we first explore a dual excitation model where the subject is responding to odors while the 70% of the OSNs are optogenetically activated using an Orco-Gal4 insert that drive the expression of a UAS-channelrhodopsins insert. Thereby, we can assess if and how the olfactory behavior is modified. We measure the effects of light excitation on the response to several odorant concentrations in a T-maze paradigm. The dose-response curve of these flies still depends on odor concentration, but with reduced sensitivity compared to olfactory stimulation alone. These results are consistent with the behavioral tests performed with a background odor and suggest an additive effect of light and odor excitation on OSNs. We also use this optogenetic tools to alter the activity of a type of antennal perineural glial cells, and we observe changes in the olfactory perception, this suggest that there is interaction of these glial cells with the olfactory receptor neurons.

This work was supported by the Spanish Ministry of Science, Innovation and University [MCINN-24-PID2023-149482NB-I00], Spanish Ministry of Economy, Industry and Competitiveness [SAF2013-48759-P and BFU2017-85882-P], the University of Oviedo [PAPI-17-PEMERG-2 and PAPI-GR-2016-0012], and the Principality of Asturias Government [IDI-2018-000182]. R.C., A.C.S. and L.C.C. were funded by Severo Ochoa PhD fellowships from the Principality of Asturias Government.

The sickness perfume: validation of a percept-first body odor augmentation

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: body-odor; perception; sick; healthy

Body odor conveys socially relevant information about health, stress, and kinship. However, its inherent complexity presents significant challenges for experimental investigation. In two studies (N=40 each) we tested if adding a single monomolecular odorant to natural body odor could induce a targeted perceptual shift, specifically the scent of sickness, while maintaining perceived naturalness.

Sickness manipulation was created by augmenting axillary body odor samples with p-Tolyl Acetate, an odorant which is described with labels that are also used for sickness-related body odors.

In Study 1, participants rated the augmented body odor as significantly more sick than the natural odor ($z = 2.95$, $p = .006$), without being rated as more artificial ($z = 1.92$, $p = .55$) or intense ($z = -1.59$, $p = .11$). A triangle test confirmed participants perceived the augmented odor as a variant of natural body odor, distinct from the pure odorant. In Study 2, we compared three different augmentations of natural body odor: 4-Decanolide (supposed to enhance the health percept), Eucalyptol (neutral), and p-Tolyl Acetate (sick). The 'sick' manipulation was rated as significantly more sick and less approachable than the healthy (sick: $z = 4.63$, $p < .001$; approach: $z = -4.48$, $p < .001$) and neutral manipulations (sick: $z = 5.60$, $p < .001$; approach: $z = -2.84$, $p = .014$). Further, the 'sick' manipulation elicited stronger disgust-related muscle activity (m. levator labii superioris) than the healthy manipulation ($z = 3.37$, $p = .003$), and shallower breathing inhalation compared to the natural body odor ($z = -2.82$, $p = .024$).

These findings reveal a simple, effective method for creating targeted body odor percepts. This technique provides a new tool for systematically investigating the nuanced role of body odor in social communication.

The study was funded by the "Volkswagen Foundation" as part of the research project "Olfactorial Perceptrics".

Neural and behavioral discrimination of bitter taste in rats

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Type of abstract: POSTER

Subject area: Taste - Other

Keywords: Taste, Bitter, Neural activity, Gustatory cortex, behavior, Discrimination

Bitterness is often considered a single, uniform taste quality. However, emerging evidence suggests that under the right conditions, animals and humans can distinguish between different bitter compounds, even when their intensity is factored out. In this study, we investigated the behavioral and neural discrimination of bitter tastes in rats (Long-Evans), to test whether bitterants can be discriminated rather than perceived as one general sensation. First, we calibrated iso-intense concentrations for several bitterants so that each compound was matched for equal perceived intensity. Using these balanced stimuli, we trained rats in a taste discrimination task while increasing tasting time. A validation test with one rat, discriminating quinine from potassium chloride (KCl), resulted in over 80% correct choices. This high performance confirmed the reliability of our behavioral paradigm for assessing taste discrimination. Next, we initiated Neuropixels recordings of neural activity in the gustatory cortex (GC) while delivering three bitterants – propylthiouracil (PROP), quinine, and denatonium benzoate – each at two iso-intense concentrations. Analysis of these neural data is currently underway and will focus on identifying patterns of activity in the gustatory cortex in response to different bitterants. These data will be used to examine the neural encoding of bitter stimuli and its relationship to behavioral discrimination performance.

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References

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Sensory responses of olfactory and vomeronasal neurons in does are influenced by buck odors and their reproductive status

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Type of abstract: POSTER

Subject area: Olfaction - Peripheral processing

Keywords: Main olfactory epithelium, Vomeronasal organ, Olfactory stimuli, Calcium imaging, Reproductive status, Goat

The "male effect" refers to the phenomenon where the introduction of a sexually active male (buck) stimulates ovarian activity and induces estrus in anovulatory females (does) after seasonal anestrus. This effect is mediated by sensory cues, especially chemicals from buck hair, which act via the female's olfactory system to trigger neuroendocrine changes, leading to increased secretion of gonadotropin-releasing hormone and luteinizing hormone surges. However, the specific chemicals in buck hair and the exact sensory pathways used by females remain elusive. Here, we investigated whether sensory cells from the main olfactory epithelium (MOE) and vomeronasal organ (VNO) of does respond differently to olfactory stimuli from sexually active bucks (SAB) and wethers (CAS, castrated males), and how this response is influenced by female reproductive status (breeding season, anestrus, or ovariectomized (OVX)). To do so, freshly dissociated MOE and VNO cells from does in the three states were exposed to chloroform/methanol and aqueous extracts from SAB and CAS buck hair. Calcium imaging was used to assess neuronal activation. Our results showed that across all extraction methods, more sensory neurons were activated by SAB hair extracts than by CAS extracts. Notably, MOE cells from anestrus does showed higher activation to SAB extracts compared to cells from breeding season or OVX does. The majority of responsive cells were identified as non-mature olfactory neurons. Our findings indicate that female goats can discriminate olfactory cues from sexually active and castrated males via both MOE and VNO pathways. The increased MOE responsiveness during anestrus suggests an enhanced role of the MOE in mediating the "male effect" when females are not in their regular breeding season.

This work was supported by a grant from Région Centre Val de Loire (France) and the INRAE PHASE Department (France).

Role of prolactin on the reconfiguration of the accessory olfactory bulb mitral cell electrical activity and behavioral responses in females

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: prolactin, accessory olfactory bulb, mitral cell, electrical activity, reproductive behavior

Reproduction in mammals is highly driven by odors processed by the accessory olfactory bulb (AOB). Prolactin (PRL) participates in reproduction and its receptors are expressed in the mitral cell layer (MCL) of the olfactory bulb. Acute injection of PRL alters AOB activation and augments the exploration of male stimuli. In the current project, we assessed the participation of PRL on reproductive behaviors and the AOB physiological responses by PRL. Adult CD1 female mice received PRL for 10 days (5mg/kg) to generate hyperprolactinemia (hPRL) before subjected to olfactory preference and sexual behavioral tests; slices to record the basal electrical activity of the MCL-AOB and in presence of PRL were obtained from behavior-hPRL group, behavior control group, lactating group (physiological hPRL), estrous and diestrus group. Results show that PRL promotes behavioral alterations: increased olfactory preference for sociosexual stimuli and altered sexual interaction, with more rejections towards the male and less stimulation received. PRL administered during recording did not modify the total power of the MCL-AOB of any of the groups. For the total potency of the MCL basal activity, behavior group showed higher activity but behavior-hPRL and estrous groups showed significantly lower activity, compared to the other groups. Our results show that PRL during the recording does not alter the electrical activity of the MCL, the basal activity of the MCL-AOB is lower in the estrus compared to diestrus and lactation, and reproductive behavior increases the electrical activity of MCL, however, a period of hPRL prior to the behavior prevents this increase. These results suggest that PRL might have a long-term effect on the electrical activity of the AOB, since a hPRL period alters the behavioral responses of the females and prevents the increase in MCL-AOB activity generated by behavioral training, suggesting that PRL might reconfigures the AOB circuits.

References

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Identification of emotion-influencing aroma components in Sichuan pepper based on psychophysical and psychophysiological methods

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Electrophysiology, Sensory analysis, Flavour recombination, Emotional response

Sichuan peppers (*Zanthoxylum spp.*) are a traditional Chinese condiment that has gained prominence in Asian cuisines. Rich in volatile and bioactive compounds, Sichuan peppers possess a distinct flavor and are hypothesized to affect human emotions via olfactory and trigeminal pathways. A comprehensive investigation into the mechanisms by which Sichuan pepper aroma influences emotions may offer valuable insights for advancing flavor science, nutritional strategies, and mental health research. Numerous studies have identified several chemical components that may be associated with emotional responses to Sichuan pepper, but our knowledge of the perceptual and emotional responses these components is still very limited.

To achieve this goal, we constructed 40 odor stimuli containing the 9 key volatile compounds from Sichuan pepper in single and mixed systems and delivered these stimuli using an olfactometer. The perception and emotions evoked by these olfactory stimuli were evaluated with response on the scales displayed on screen and multi-channel physiological monitoring (including electroencephalogram (EEG), electrocardiogram (ECG), electrodermal activity (EDA) and respiratory rate (RR)).

Preliminary data analysis allowed us to identify at least 4 key compounds associated respectively with the positive or negative emotional responses to Sichuan pepper. The study also found that the same compound triggered different emotional responses in different carriers. We will further analyze the effects of each key compound in a single or mixed system to explore the laws and mechanisms by which they stimulate emotional responses. It is expected that our findings can provide theoretical guidance and practical applications for optimizing food formulations and improving emotional valence while maintaining the flavor characteristics of Sichuan pepper in foods. This study received support from public financial sources.

Learning tunes olfactory sensitivity

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Type of abstract: POSTER

Subject area: Olfaction - Peripheral processing

Keywords: Learning, 2-photon imaging, behaviour

Olfactory learning enables animals to form essential associations between odours and biologically meaningful outcomes, such as locating food or avoiding predators. We are investigating how learning modifies the olfactory circuitry to support these diverse behavioural responses. To do this, we developed a behavioural paradigm that allows us to measure innate odour sensitivity in naïve mice. Our findings reveal that this innate sensitivity can vary by several orders of magnitude.

We then measured neural sensitivity using in vivo multiphoton Ca^{2+} imaging of odour-evoked activity at the input to the olfactory bulb. We show that appetitive learning induces a large shift in the neural input to the olfactory bulb. Importantly, the tuning curve of the olfactory input matches the concentration gradient that was presented during the learning paradigm. Preliminary data further indicate that this tuning curve adapts to different concentration gradients used in appetitive learning, while fear conditioning results in an increased gain at lower concentrations.

These results suggest that the behavioural demands of a task can evoke distinct context-dependent changes in odour sensitivity at the level of olfactory input to the brain.

This research has been generously supported by the BBSRC White Rose DTP.

Optimal superimposition of ligands for structure-activity modeling

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Type of abstract: POSTER

Subject area: Other

Predicting the detection and percept of an odorant from its physiochemical properties is a central question in chemosensory research. While much work has been done to study and predict psychophysical reports of olfactory perception, these approaches often have limited utility for investigating how chemosensory stimuli are represented by populations of sensory neurons. On the other hand, system-wide recordings, such as those conducted in the vomeronasal system, enable the exploration the relationships between chemosensory receptors and their ligands through the use of quantitative structure-activity relationship (QSAR) and similar modeling methods. These methods often rely on the superimposition of some combination of ligands, receptor binding sites, and pharmacophore models, but obtaining optimal poses for superimposition is often a challenging problem with nonconvex, multimodal optimization landscapes. To more reliably obtain globally optimal alignment poses for downstream QSAR analyses, we have developed a novel branch-and-bound strategy that attempts to strike a balance for the explore/exploit tradeoff in optimization. Briefly, our strategy uses the lower convex hull of the bounds of remaining search regions—analogue to a Pareto frontier—for node selection, and it is generalizable to a broad class of alignment problems in rigid transformation space either with or without bond rotations. We benchmarked our strategy using a panel of olfactory stimuli (Vosshall 2019) against off-the-shelf global optimization techniques that have previously been used for molecular alignment, finding that our new approach substantially improves the quality of pairwise superimposition of odorants without increasing runtime, enabling more powerful QSAR modeling.

Olfactory symptoms in patients of the Post Covid Center Erlangen

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Post Covid, Smell loss

Years after the Sars-CoV2 pandemic, millions of people still suffer from long term symptoms of their infection, summarized as post-acute CoViD-19 syndrome (PACS). PACS comes in many forms and with a diverse symptom spectrum, including fatigue, cognitive impairments, and olfactory dysfunction. In this interdisciplinary project, we conducted olfactory testing on patients of the Post Covid Center Erlangen between March 2024 and May 2025. 142 patients with confirmed PACS diagnosis as established by specialists were included in our study. We assessed olfactory function in each patient using the Sniffin' Sticks TDI test and self-assessment questionnaires. These findings were put in context with a wide range of psychophysiological tests and scales as well as sociodemographic data. The standardized TDI test resulted in 43.66% of patients showing no signs of olfactory deficits, while 53.52% of patients reported subjectively lower olfactory function compared to before their infection. For patients that rated their olfactory function as 5 out of 10 or lower, the self-assessment correlated significantly with the TDI score. On average, olfactory scores were in the 31st percentile compared to age/gender-matched normative data. 30.99% of patients reported qualitative olfactory dysfunction. The hedonic values of 3 odors of the identification test were perceived significantly different between hyposmic and normosmic patients. A lower percentile rank for olfactory function was associated with more severe signs of insomnia and the fatigue subitem of the patient health questionnaire, overall more severe symptoms in the burden of somatic symptoms, and worse scores in the cognitive subtests for verbal fluency and working memory. Overall, we offer a comprehensive and detailed characterization of olfactory symptoms and their relationship to other manifestations within the PACS spectrum in a patient cohort.

Olfactory dysfunction in a mouse model of kidney disease

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Olfactory dysfunction, discrimination, identification, kidney disease

Mexico has a high prevalence of kidney disease (KD). KD is characterized by functional and structural abnormalities of the kidneys. KD patients report olfactory alterations that affect their quality of life and can lead to unbalanced feeding behavior, altering metabolism. The onset and evolution of the pathophysiology of the olfactory alterations have been little addressed. In the present study, a KD model was generated in adult C57BL/6J female mice by oral administration of adenine (tx; 50 mg/kg, n=10). To assess olfactory alterations in this model, we employed four behavioral tests: the olfactory threshold test (OTT), the habituation/dishabituation test (HDT), the olfactory food preference test (OFPT), and the buried food test (BFT). These tests evaluated the mice's ability to detect (sensitivity-OTT and locate food-BFT using olfactory cues), differentiate odors (memory and discrimination processes-HDT), and their preference (OFPT). The tests were performed before the tx and 4, 6 and 8 weeks after adenine-tx. Before adenine-tx, all female mice showed intact olfactory capacity. Four weeks after adenine-tx, mice displayed decreased odor sensitivity-OTT, showing reduced sniffing time and decreased HDT performance over time, becoming more pronounced at 8 weeks after adenine-tx. Regarding BFT, in week 8 after adenine-tx, mice displayed a decrease in the latency for uncovering the buried food. Interestingly, at 4 and 6 weeks after adenine treatment, KD mice showed an increase in time spent eating the buried food. In OFPT, neither group showed any olfactory food preference at 4, 6, and 8 weeks after adenine-tx. However, we observed that the percentage of the total exploration time to each food stimulus decreased in KD mice. Our data indicate that adenine-tx disrupts olfactory function in mice modulating the detection processes and altering memory and discrimination processes. Further experiments are needed to unravel the olfactory dysfunction in the KD mouse model.

References

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Spontaneous Eye Blink Rate Increased After Consuming Individually Preferred Beverage, but not after Water or a Palatable Chocolate Milk

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Type of abstract: POSTER

Subject area: Taste - Central processing

Keywords: SEBR, dopamine, food reward

Spontaneous eye blink rate (SEBR) has been used as a non-invasive proxy of dopaminergic activity, as it's linked to short-term changes in dopamine, especially related to reward prediction error and motivation. This connection may be particularly relevant in food reward, given that dopamine release in the dorsal striatum increases with perceived food pleasantness, and dopamine signaling plays a key role in flavor-nutrient conditioning. The influence of hedonic responses based on individual food preferences on SEBR remains largely unclear. In a within-subject design, we recruited 60 participants from Toros University undergraduate students and academicians ($M=23.73$; $S=4.85$). Each participant completed three sessions on separate days in a counterbalanced design, during which they consumed plain water, chocolate milk, or a self-chosen favorite beverage. Three Ag/AgCl self-adhesive electrodes were placed vertically over the orbicularis oculi and one over a neutral site (back of the neck). Eye blinks were recorded via electromyographic signals for 5 minutes both before and after beverage consumption. Our results revealed a main effect of time, indicating an overall increase in blink rate from pre to post-consumption across sessions [$F(1,59)=4.07$, $p=.041$], such that regardless of the type of session, on average the SEBR increased from pre to post-consumption. There was no significant main effect of session, however, post-hoc paired sample t-test revealed that SEBR significantly increased in the favorite beverage condition [$t(59)=2.60$, $p_{\text{bonf}}=.012$]. Our findings revealed that spontaneous SEBR significantly increased following the consumption of participants' favorite beverage only, whereas no such effect was observed for water or chocolate milk. This increase may reflect affective or motivational responses driven by subjectively rewarding stimuli and enhanced dopaminergic activity, highlighting the potential of SEBR as a non-invasive proxy of hedonic processing.

References

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Ongoing Neuronal Activity in the Gustatory Cortex Actively Contributes to the Consolidation of Taste Memory

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Type of abstract: POSTER

Subject area: Taste - Behavioral/perceptual

Keywords: Memory Consolidation Gustatory Cortex Conditioned Taste Aversion (CTA) Optogenetics Neuronal Activity Systems Neuroscience Temporal Dynamics Aversive Learning Cortical Plasticity

Long-term memory consolidation has traditionally been attributed to autonomous molecular cascades. However, whether ongoing neuronal activity plays an active, time-dependent role in driving this process remains unresolved. Using conditioned taste aversion (CTA) in rats, we are investigating the potential causal contribution of post-learning activity in the gustatory cortex (GC) a key site for taste learning. To this end, we employ long-term optogenetic silencing (using AAV containing eOPN3 channel) of GC pyramidal neurons during discrete two-hour post-training windows (0–2 h, 2–4 h, 4–6 h, and 6–8 h), using chronically implanted fiber optics for light delivery. CTA retention is quantified via sucrose consumption and aversion index. We hypothesize that silencing GC activity during a critical 4–6h post-training window (previously described as a CTA consolidation phase) will impair memory retention, whereas silencing during earlier or later periods will have minimal effects. If confirmed, this would suggest that GC activity during a specific consolidation window is necessary for memory stabilization. Such findings would challenge purely molecular models of memory and support a framework in which consolidation depends on temporally structured neuronal activity. This work could refine our understanding of systems-level plasticity and inform future strategies for targeting memory-related disorders.

Dose-response relationship of sugar-sweetened beverages with and without non-nutritive sweetener sucralose and diet-induced thermogenesis

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Type of abstract: POSTER

Subject area: Taste - Other

Keywords: Multisensory Perception, Artificial Sweeteners, Diet-Induced Thermogenesis, Energy Expenditure

There is a strong association between sugar-sweetened beverage intake and weight gain, obesity and metabolic syndrome. Sucrose and sucralose are often used in combination in sweetened products and can be encountered in many “diet” products, sports products and regular products. However, very little is known about the interactions of nutritive and non-nutritive sweeteners on metabolism. When sweetness and calories are mismatched, particularly when the drink is “far too sweet” for its calories (from maltodextrin), a decreased diet-induced thermogenesis (DIT) response is observed relative to matched beverages. One difficulty in interpreting these observations is that there is no benchmark for a dose-response DIT relationship for sugar-sweetened beverages. Here we investigate the effect of calories in and sweetness of beverages on metabolic response to sucrose across a range of nutrient doses. In a mixed design, we used 6 doses of sucrose (from 0 to 150 kcal in 30 kcal steps, adjusted for individual BMR) as a within-subjects independent variable, and as a between-subjects variable we added no extra sucralose ($n = 4$) or a constant dose of sucralose equi-sweet to 75 kcal sucrose ($n=4$). Unexpectedly we observed that drinks that are “too sweet” lead to a higher DIT ($F(5,30) = 7.636$, $p<.001$) relative to sucrose on its own, particularly in the range of 90-120 kcal. We conclude that mismatches between sweetness and calories lead to aberrant metabolic responses. Future studies may further investigate the influence of combining non-nutritive sweeteners with different types of nutritive sweeteners, such as sucrose vs maltodextrin.

The study was supported by the TUBITAK 2224a project

Tracking neuronal activity and connectivity across CTA learning and extinction

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Type of abstract: POSTER

Subject area: Taste - Other

Conditioned taste aversion (CTA) is a powerful form of associative learning in which a single pairing of a palatable taste with visceral malaise leads to long-lasting avoidance. While its behavioral expression is well characterized, much less is known about how neuronal activity and connectivity change throughout the learning process. Most studies focus on isolated timepoints before and after conditioning, leaving the dynamic neural transformations that occur during memory formation and extinction poorly understood.

To address this, we recorded gustatory cortex (GC) activity using Neuropixels across three days of CTA: baseline, acquisition, extinction test, and final test. We tracked how GC responses to the conditioned stimulus (sucrose) evolve over time, analyzing single-neuron coding, ensemble dynamics, and shifts in functional connectivity. Preliminary findings suggest that changes in activity unfold in discrete stages and align with the behavioral transition from aversion acquisition to extinction.

We also examined how responses to non-conditioned tastes change across days, testing whether GC activity reflects the generalization and eventual specificity of aversion. Using facial video analysis alongside neural recordings, we relate behavioral taste reactivity to evolving neural population states.

These data offer a high-resolution, time-resolved view of how sensory cortical representations and connectivity reorganize across learning and extinction, providing new insights into the temporal dynamics of memory formation in cortex.

This work was supported by the Israel Science Foundation (Grant No. 2895/20, Anan Moran).

Evoking olfactory imagery through glass and multisensory artistic stimuli.

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: Olfactory imagery, crossmodal correspondences, multisensory stimuli, grounded cognition

Olfactory imagery, the ability to perceive smells without physical stimuli, is subjective and challenging. Given the individual and biographical nature of olfactory memory, this project explored whether multisensory artistic stimuli and odorless glass as a projection surface facilitate imagined olfactory experiences. To investigate this, a series of *Glass Tastings* was developed combining guided narration, non-figurative drawings (texture, color, shape), touch, sound, and crafted glass objects to focus attention and activate sensorimotor processes. Conducted with 291 participants in in-person and digital formats (including browser-based solo experiences and Zoom workshops), 151 data sets were qualitatively analyzed using interviews and written reflections. Despite methodological differences, consistencies emerged: participants experienced olfactory imagery in highly individual ways, with tendencies for certain stimuli—e.g., touching wood often evoked episodic odor recall. Texture drawings stimulated trigeminal and temperature-related sensations, while pitch-based sounds modulated perceived temperature of imagined smells, suggesting sound-temperature-odor correspondences. Furthermore, hunger states influenced imagery content, with hungry participants reporting more food-related odor imagery. Notably, participants with olfactory dysfunction (n=7) also reported olfactory imagery, identifying glass as key to their experience. Findings highlight the potential of a multisensory artistic approach using glass to evoke olfactory imagery, aligning with grounded cognition theory that embodied, crossmodal experience activates olfactory imagination. Glass, as an odorless medium, effectively focused attention and enabled vivid imagery. This project is supported by Alexander-Tutsek Foundation, Women's Promotion Fund of Bauhaus Research School, and Graduate Center Koblenz University of Applied Sciences.

Modulation of the attentional system by trigeminal olfactory stimuli

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Keywords: olfaction attention trigeminal

Attention processing involves the thalamus. If the olfactory pathway bypasses it and projects directly to cortical areas, this is not the case when odor activates the trigeminal pathway. Here, we studied how attention is modulated when odors include a trigeminal component, through both olfactory-driven and cross-modal attention tasks.

In the first phase, we explored the impact on sustained attention to odors, focusing on olfactory habituation. 35 participants rated intensity and liking of repeated odor presentations (20 times). Results showed that trigeminal odor (containing “fresh” menthol derivative compound) showed reduced habituation, sustaining intensity ratings, unlike the control odor which declined over time ($t(46) = -2.16$, $p = 0.0359$). These results suggest that trigeminal input helps maintain attentional resources toward olfactory stimuli, reducing the natural decline in salience over repeated exposure.

In the second phase, 40 participants (20 per group) were asked to perform an auditory oddball task while wearing a 14-electrode EEG headset, twice. In the first time, no odor was used (baseline), then during the second time, they were exposed to one of two versions of a fragrance: one “simple” odor and one enriched with a trigeminal component. Participants exposed to the simple odor reported the second task felt more “mentally demanding”, “difficult” and “harder to follow”. In trigeminal odor group, a significant increase in auditory P3 amplitude was observed during the second repetition (t-test, $p = 0.021$, at F3), suggesting that trigeminal odor exposure helped maintain attentional engagement even for non-olfactory stimuli.

These findings support the idea that trigeminal activation during olfactory stimulation engages thalamic circuits and modulates attentional resource allocation. Altogether, these results offer perspectives for further investigations into the processing of trigeminal chemosignals and attention circuitry.

Can olfactory awareness increase after exposure to odors?

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Subject area: Olfaction - Other

Keywords: olfactory awareness, odor exposure, metacognitive aspects of olfaction

People differ in terms of olfactory abilities and awareness of ambient odors. Olfactory training (OT), mainly used for smell rehabilitation, has shown positive effects on olfactory and cognitive abilities. This study tested whether standardized OT enhances odor awareness, the significance of olfaction, odor identification and verbal fluency in children aged 6-9 years.

A total of 101 children (52 girls) participated in a 12-week OT. The experimental group (57 children) smelled four odors (rose, eucalyptus, lemon, cloves) twice daily, while the placebo group (44 children) received odorless OT.

Results showed a slight increase in odor awareness and significance of olfaction, especially in the experimental group and among children with lower baseline odor awareness. OT did not affect odor identification or verbal fluency.

In conclusion, OT may improve metacognitive aspects of olfaction in children with less odor experience. Further research is needed to clarify its effects on olfactory development.

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Prevalence of chemosensory dysfunction among US adults with and without a history of cancer in NHANES 2013-2014

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Subject area: Multisensory - Other

Keywords: gustation, olfaction, cancer, chemosensory perception, oncology, chemosensory dysfunction

Chemosensory dysfunction is a recognized quality-of-life burden and safety risk for adults, particularly cancer survivors. We conducted a cross-sectional analysis of National Health and Nutrition Examination Survey (NHANES) data from 2013–2014 to determine the prevalence of chemosensory dysfunction. Adults ≥ 40 years ($n=3,090$) completed questionnaires assessing cancer history, self-reported problems with smell and taste in the past 12 months, changes in perception since age 25, and phantom odors. Olfactory and gustatory function were psychophysically evaluated using the 8-item Pocket Smell Test (dysfunction = ≤ 6 correct identifications) and bitter identification with a 1 mM quinine solution. Weighted prevalence estimates were calculated using survey design-adjusted methods. Survey-weighted quasibinomial generalized linear models were used to assess the effects of demographic variables. Among 3,090 participants, 418 reported a history of cancer. It is estimated that 27.0% of those with cancer (CI:21.4–32.6%) reported smell problems in the past year, compared to 20.7% (CI:17.5–23.0%) in those without cancer ($p<0.014$). For taste, it is estimated that 11.8% (CI:7.0–16.7%) of those with cancer reported dysfunction, compared to 9.5% (CI:7.6–11.5%) without cancer ($p=0.56$). Psychophysical testing estimated olfactory dysfunction in 19.7% (CI:14.2–25.2%) of those with cancer, significantly higher than the 10.7% (CI:8.5–12.9%) prevalence in those without cancer ($p<0.0001$). Quinine-based testing found taste dysfunction in 13.6% (CI:6.9–20.3%) of those with cancer and 17.9% (CI:15.9–20.0%) without cancer ($p=0.2$). Demographics were not significantly associated with smell or taste dysfunction in those with cancer. Adults with a history of cancer have a higher prevalence of both subjective and psychophysically measured chemosensory dysfunction, highlighting the need to include chemosensation assessment in survivorship care.

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Multivariate pattern analysis in the human brain reveals distributed representations of odors beyond traditional olfactory regions

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Subject area: Olfaction - Central processing

Keywords: olfactory processing, multivariate pattern analysis, fMRI

Neuroimaging studies on the human sense of smell have primarily highlighted activity in the primary and secondary olfactory cortices. However, little is known about how odors are processed in more downstream or widespread brain regions. We argue that this limited understanding is partly due to the predominant use of traditional mass-univariate fMRI analyses, which examine each voxel independently. Here, we aimed to identify distributed activation patterns across the whole brain involved in odor discrimination.

In our human fMRI study, we presented ten different odorants to 30 participants using an MRI-compatible olfactometer while recording blood-oxygen-level dependent (BOLD) signals. We then estimated whole-brain activation patterns for each participant. To identify where in the brain odor identity could be distinguished, we conducted a multivariate whole-brain searchlight analysis. In this approach, a small spherical cluster (the “searchlight”) is systematically moved through the entire brain volume, and within each local neighborhood, we applied 10-fold cross-validation combined with linear discriminant analysis to test for odor classification.

The resulting group-level accuracy maps revealed odor discrimination significantly above chance level not only in expected regions such as the piriform cortex, anterior olfactory nuclei, and amygdala, but also in further downstream areas including the parietal cortex and precuneus.

Our findings demonstrate that multivariate pattern-based analyses provide a powerful means to investigate, across the whole brain, whether specific regions can differentiate between individual odors or odor categories. Such approaches hold great promise for uncovering how chemical differences between odorants are ultimately transformed into distinct neural representations and perceptual experiences.

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Do anxiety chemosignals influence our smell sensitivity for common odors? Research utilizing dental phobia participants

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Type of abstract: POSTER

Subject area: Olfaction - Behavioral/perceptual

Chemocommunication plays a crucial role in human nonverbal communication. While the behavioral effects of anxiety-related chemosignals on recipients are well-documented, it remains unclear whether such stimuli can modulate sensitivity for common odors. This study aimed to investigate whether exposure to anxiety chemosignals influences olfactory sensitivity.

We assessed the odor sensitivity of 36 participants to phenylethyl alcohol (PEA) and n-butanol following exposure to anxiety and neutral chemosignals (generated by dental phobia participants), and a blank condition. Additionally, a fourth condition involved viewing a horror movie to compare the effects of anxiety induced by visual stimuli with those of chemosignals. Results revealed a significant increase in sensitivity to PEA following exposure to anxiety chemosignals compared to the blank condition, whereas no significant change was observed for n-butanol.

To further analyze the chemical composition of the applied chemosensory stimuli, we employed untargeted one-dimensional gas chromatography-mass spectrometry (GC-MS) and gas chromatography-olfactometry (GC-O). While GC-MS data did not identify compounds with significantly higher normalized peak areas in anxiety sweat samples compared to neutral sweat samples, GC-O analysis suggested that dodecanoic acid and 3-hydroxy-3-methylhexanoic acid were key contributors to the odor profile of anxiety sweat. In contrast, tetradecanoic acid and patchouli alcohol were prominent in neutral sweat samples. These findings provide evidence that anxiety chemosignals enhance sensitivity to common odors, offering new insights into the role of emotional states in olfactory perception. Moreover, this study contributes to a deeper understanding of the chemical composition of sweat involved in human chemocommunication.

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Bitter peptides of pea protein hydrolysates induce gastric signals of satiation and reduce healthy subjects' total energy intake

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Subject area: Taste - Peripheral processing

Keywords: plant-based proteins, food intake, satiety, bitter taste receptors,

With the shift towards plant-based diets, the bitterness of plant-based proteins, isolates, and hydrolysates has become an important consideration, as these sources are particularly prone to developing bitter flavors. Meanwhile, the satiating effects of proteins and bitter-tasting food constituents have been demonstrated. Building on our previous findings that non-bitter proteins can be cleaved into bitter peptides during gastric digestion^{1,2}, we hypothesized that bitter peptides from plant protein hydrolysates might elicit gastric satiation signals.

In vitro, gastric digests of a more bitter-tasting (MBT) and a less bitter-tasting (LBT) pea protein hydrolysate (PPH) both stimulated proton secretion (PS) and serotonin release in parietal HGT-1 cells, implicating bitter taste receptors (TAS2Rs). A sensory-guided LC-MS approach identified six bitter peptides from MBT-PPH or LBT-PPH. TAS2R4 and TAS2R43 involvement was confirmed via CRISPR-Cas9 knockout. All peptides equally stimulated PS, while the three LBT-PPH-derived peptides more potently triggered serotonin release over a concentration range of 0.005 to 50 µg/ml.³

Given the lower yield of bitter peptides in LBT-PPH, we tested the satiating effects of both hydrolysates in a randomized, single-blinded, controlled proof-of-concept human study. Nineteen moderately overweight male subjects consumed 300 ml boluses of a 75 g glucose solution (control) or solutions containing 15 g LBT-PPH or MBT-PPH. MBT-PPH administration delayed gastric emptying by 65% ($p < 0.0001$) and reduced energy intake from a standardized breakfast by 126 ± 329 kcal ($p < 0.05$) compared to control. In contrast, LBT-PPH decreased plasma ghrelin levels, indicating a satiating potential, although total energy intake remained unchanged.

These findings highlight the promise of PPHs as functional ingredients in weight management, with bitter peptides — whether formed during digestion or already present — playing a key role in promoting satiation.

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The effect of olfactory and auditory contexts on associative memory in an fMRI study

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Subject area: Olfaction - Other

Odors are known to evoke vivid and emotionally salient memories, but evidence for their facilitatory effect on associative memory is mixed and task-dependent. This study aimed to examine how olfactory and auditory contexts influence associative memory, and whether odors enhance performance beyond general sensory stimulation. In Experiment 1, thirty normosmic participants completed a functional MRI (fMRI) associative memory task with encoding and retrieval phases. During encoding, participants viewed neutral images paired with distinct map locations. Each image-location pair was presented three times and accompanied by either an odor (via olfactometer) or a sound (via headphones). Retrieval included three tasks: (i) location recall, (ii) modality recognition with confidence ratings, and (iii) image recall. Both encoding and the first retrieval task were performed inside the scanner. No significant behavioral differences were found between sensory conditions ($p > 0.05$). However, fMRI showed modality-specific activation: olfactory context engaged the piriform cortex and amygdala, while auditory context activated the primary auditory cortex and insula. In Experiment 2, we tested whether odors modulates memory performance compared to a no-stimulation control.

Although analyses are ongoing, preliminary behavioral results suggest enhanced spatial performance in an associative memory task when encoding occurred with odor, reflected in shorter distances to target locations compared to control in high confidence trials. These findings support the idea that odors and sounds engage distinct sensory-memory pathways, and tentatively suggest that odors may improve spatial performance in an associative memory task when contrasted with an unstimulated context, aligning with and extending prior mixed evidence on olfactory memory enhancement.

Hybrid CNT-FET-Odorant Receptor Platform for Ultra-Sensitive Detection of Volatile Organic Compounds

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Subject area: Other

We present the development of a bioelectronic nose that combines carbon nanotube field-effect transistors (CNT-FETs) with insect odorant receptors (ORs) to enable highly sensitive and selective detection of volatile organic compounds (VOCs). This platform integrates the molecular specificity of mosquito-derived ORs with the electrical responsiveness of CNT-FETs to transduce ligand binding into measurable electronic signals. Preliminary results demonstrate the feasibility of this approach: we have fabricated multiplexed CNT-FET arrays with high device yield, functionally expressed multiple mosquito ORs, and validated selective VOC detection in liquid environments. This modular system has potential applications in chemical threat detection, environmental monitoring, food safety, and non-invasive diagnostics. The project is a multidisciplinary effort bridging olfactory biology and nanoelectronics, with industrial collaboration supporting translation from lab to field.

Topic: Biologically inspired and bio-based sensors in olfaction

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Targeting Highly Expressed Olfactory Receptors to Improve Olfactory Testing and Training

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Subject area: Other

Olfactory testing and training constitute important foundations of diagnostic and therapeutic management of patients presenting with olfactory loss. The precise repertoire of human olfactory receptors (ORs) engaged by standard odorants used in olfactory detection thresholds (mainly phenylethyl alcohol, PEA), identification tests and olfactory training protocols is surprisingly under-investigated, limiting our understanding of these methods. Notably, transcriptomic atlases of human ORs show that individuals share a majority of highly expressed ORs, highlighting their potential functional significance in human olfaction. Consequently, based on the largest atlas available, our study firstly established a list of highly expressed ORs (a group we referred to majORs in contrast to the low-expressed minORs). We focused on 80 majORs (those expressed above 80 copies/ 20 ng RNA) accounting for approximately 80% of all ORs expressed in the human olfactory mucosa. Secondly, based on a tested machine learning model developed from the M2OR database, we performed an *in silico* study exploring the potential agonists of these majORs from a list of 5729 well-described odorants. This resulted in a list of broad agonist odorants ranked according to their ability to theoretically interact with a large number of majORs, compared to those currently used for olfactory threshold testing and olfactory training. As a result, we found that PEA, for example, seems to activate less than 3% of majORs, whereas galaxolide, for example, seems to activate around 75% of majORs. Therefore, we hypothesize that including these broad agonist odorants might improve olfactory testing accuracy and olfactory training outcome by stimulating a greater number of olfactory neurons.

Beyond the Human Nose: AI in Odor Recognition and Mixture Analysis

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Type of abstract: POSTER

Subject area: Olfaction - Other

Odor recognition and mixture analysis are complex, non-linear problems where one compound can alter the perceived odor of a mixture. Odor mixtures involve dynamic interactions, with some compounds dominating or only detectable at specific concentrations, creating new sensations when combined. This complexity makes developing a machine learning (ML) model to predict an odor mixture's profile challenging. However, doing so would be valuable, as most everyday smells are mixtures. A significant hurdle is the lack of a standardized dataset, compounded by human subjectivity that adds variability and complicates clear sample labeling. Additionally, the concentration of compounds and the medium used to present odors significantly influence perception and assessment, hindering the generalization of predictions across different datasets.

In this work, we trained a convolutional neural network and a linear classification algorithm, OWSum, to predict the origins and aromas of 16 whisky samples from American and Scotch sources. By combining fast analytical tools with sensory data from 11 experienced panelists, our methods surpassed inter-panelist agreement with promising accuracy, demonstrating previously impossible data-driven sensory assessment in mixtures (up to F1: 0.71, MCC: 0.68, ROCAUC: 0.78). These methods focused only on molecular structures, not considering odor activity values, thresholds, and molecular concentrations. Thus, we would also like to introduce our work "NextML" that aims to bridge this gap by acquiring a comprehensive and a wide spectrum of molecular mixture data, including perceived intensity, thresholds, activity values and pleasantness. This data can be used to train new ML algorithms that extend the current understanding of odor recognition and mixture analysis.

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