THIRD ANNUAL MEETING

Sarasota Florida

APRIL
22-26

1981

Association for CHEMORECEPTION SCIENCES

The Association for Chemoreception Sciences

Third Annual Meeting Program

Wednesday Evening, April 22

7:00-10:00 PM — Registration, Sarasota Hyatt House Lower Lobby

Thursday Morning, April 23

8:00-11:00 AM — Registration Continues in the Lower Lobby

8:30-10:30 AM — Session I, Chair: R. Bradley, Hernando-DeSoto North

C.A. Cornwell-Jones, Princeton University.
6-HYDROXYDOPAMINE REDUCES OLFACTORY REACTIVITY IN RAT PUPS.

R.J. Contreras, T. Kosten and A. Berg, Yale University.
THE EFFECTS OF PRENATAL AND EARLY POSTNATAL SODIUM CHLORIDE INTAKE ON THE SALINE PREFERENCES AND BLOOD PRESSURES OF ADULT RATS.

C.A. Greer, W.B. Stewart and G.M. Shepherd, Yale University School of Medicine.
ODOR-INDUCED ACTIVITY IN THE OLFACTORY BULBS OF NEONATAL RATS.

D.L. Hill, R.M. Bradley and C.M. Mistretta, University of Michigan.
RESPONSE LATENCIES OF RAT CHORDA TYMPANI FIBERS DURING DEVELOPMENT.

C.M. Mistretta, University of Michigan; and B.J. Baum, Baltimore City Hospital.
TASTE BUDS IN THE CIRCUMVALLATE PAPILLA OF YOUNG AND OLD RATS.

G.K. Beauchamp, Monell Chemical Senses Center and University of Pennsylvania.
POSTNATAL INGESTIVE EXPERIENCE AND SWEET TASTE PREFERENCE IN HUMAN INFANTS.

J.M. Weiffenbach and B.J. Baum, National Institute of Dental Research and National Institute on Aging, NIH.
TASTE DETECTION THRESHOLDS: CHANGES WITH POST ADOLESCENT DEVELOPMENT.

B.J. Cowart and B.J. Baum, National Institute of Dental Research and National Institute on Aging, NIH.
SUPRATHRESHOLD TASTE SENSITIVITY: CHANGES WITH POST ADOLESCENT DEVELOPMENT.

10:30-11:00 AM — Coffee Break

11:00 AM - 1:00 PM — Session II, Chair: M. Mozell, Hernando-DeSoto North

B.M. Slotnick, The American University.
AN OPERANT PROCEDURE FOR ASSESSING TASTE FUNCTION IN RATS.

C. Christensen, M. Navazesh and V. Brightman, Monell Chemical Senses Center and University of Pennsylvania.
EFFECTS OF PHARMACOLOGIC REDUCTIONS IN SALIVARY FLOW ON TASTE PERCEPTION.

B.P. Halpern and S.T. Kelling, Cornell University.
TASTE JUDGEMENTS OF BRIEF STIMULI.

R.P. Erickson, Duke University.
A "NEW" DIRECTION IN TASTE PSYCHOPHYSICS: ARISTOTLE AND HENNING.

R.L. Doty, University of Pennsylvania.
DEVELOPMENT OF A SELF-ADMINISTERED MASS-SCREENING ODOR IDENTIFICATION TEST.

W.S. Cain, John B. Pierce Foundation Laboratory and Yale University.
ODOR IDENTIFICATION: FEMALES VERSUS MALES.

R.G. Davis, VA Medical Center.
THE EFFECT OF NON-OLFACTORY CONTEXT CUES ON ODOR IDENTIFICATION AND ON THE "TIP OF THE NOSE" STATE.

H. Boelens, H.G. Haring and D. de Rijke, Naarden International; and P.H. Punter and T. Hendriks, State University Utrecht.
MOLECULAR STRUCTURE AND OLFACTIVE PROPERTIES.

J.M. Weiffenbach, National Institute of Dental Research, NIH.
TASTE QUALITY RECOGNITION AND FORCED CHOICE PSYCHOPHYSICS.

Thursday Afternoon, April 23

2:30- 5:30 PM — Session III, Central organizations of the Olfactory and Vomeronasal Systems, Hernando-DeSoto North

Chair: F. Macrides
Speakers: J.S. Price, B.M. Slotnick and S.S. Winans

This symposium will focus on the morphological organization of the central olfactory and vomeronasal pathways. How might morphology be related to psychophysical functions and the regulation of motivated behaviors?

Thursday Evening, April 23

7:00- 8:30 PM — Session IV, Funding Processes at the NSF and the NIH, Hernando-DeSoto North

Chair: R. O'Connell
Speakers: T. Dolan, Sensory Physiology and Perception Program, NSF; J. Pearl, NINCDS, NIH; and D. Wolff, National Institute of Dental Research, NIH

A summary of the procedures and processes at the NSF and NIH leading to support of research in the chemosensory sciences. How are proposals reviewed? What are the criteria upon which support or non-support decisions are made? What is the funding outlook for the immediate future? What other federal programs support research in the chemosensory sciences? These and other questions will be examined.

8:30- 11:00 PM? — Informal mixer with cash bar, Hernando-DeSoto South

Friday Morning, April 24

8:30-
10:30 AM

Session V , Chair: B. Ache, Hernando-DeSoto South

J. Van Houten and M. DiNallo, University of Vermont; M. Wholford and A. Bulloch, University of Iowa.
CHEMORECEPTION IN PARAMECIUM: RELATIONSHIP OF FOLATE TRANSPORT TO FOLATE ATTRACTION.

W.P. Aspey, Ohio State University.
CHEMICAL COMMUNICATION AND REPRODUCTIVE BEHAVIOR IN THE SEA HARE APLYSIA BRASILIANA (MOLLUSCA: OPISTOBRANCHIA).

D. Rittschof, L.G. Williams, R. Shepherd and M.R. Carriker, College of Marine Studies.
CHEMORECEPTION IN NASCENT OYSTER DRILLS: CHARACTERISTICS OF DISTANCE CHEMOATTRACTANTS.

L. Williams, D. Rittschof, B. Brown and M. Carriker, University of Delaware.
CHEMORECEPTION IN NASCENT OYSTER DRILLS: RESPONSE TO AGONISTIC STIMULI.

B. Brown, D. Rittschof, L. Williams and M. Carriker, University of Delaware.
DISCRIMINATION BETWEEN DISTANCE CHEMOATTRACTANTS IN OYSTER DRILLS.

L. Wood, Sweet Briar College; D. Rittschof, L. Walsh and L. Williams, College of Marine Studies.
CHEMORECEPTION IN NASCENT OYSTER DRILLS: INGESTIVE CONDITIONING OFFERS THE BENEFITS OF TWO FEEDING STRATEGIES.

W.H. Pearson, D.L. Woodruff, P.C. Sugarman, S.E. Miller and B.L. Olla, Battelle Marine Research Laboratory and NOAA, NMFS.
DETECTION OF PETROLEUM HYDROCARBONS BY CRABS.

J. Atema, Boston University Marine Program
THE "INFORMATION CURRENT" IN DECAPOD CRUSTACEA.

D. Devine and J. Atema, Boston University Marine Program.
DISTANCE CHEMORECEPTION AND ORIENTATION TO FOOD ODORS IN THE AMERICAN LOBSTER.

K.A. Jones, Texas A&M University.
TEMPERATURE EFFECTS ON THE ORIENTATION TO AN OLFACTORY CUE BY GOLDFISH.

10:30-
11:00 AM

Coffee Break

11:00 AM -
1:00 PM

Session VI, Chair: B. Halpern, Hernando DeSoto South

L.M. Kennedy, Worcester Foundation for Experimental Biology; and B.P. Halpern, Cornell University.
ACTION OF GYMNEMIC ACIDS AND ZIZIPHINS ON CHEMORECEPTOR CELLS: DOSE-EFFECT AND TIME COURSE RELATIONSHIPS.

E. Bowdan, University of Massachusetts, Amherst.
RESPONSES OF TARSAL CHEMORECEPTORS OF THE APPLE MAGGOT TO OVIPOSITION DETERRENT PHEROMONE.

Session VI, Continued

C.D. Derby, Boston University Marine Program.
NARROW-SPECTRUM CHEMORECEPTOR CELLS IN THE WALKING LEGS OF THE LOBSTER, HOMARUS AMERICANUS.

J.S. Kanwal and J. Caprio, Louisiana State University.
TASTE RESPONSES OF THE GLOSSOPHARYNGEAL NERVE IN THE CATFISH.

M.M. Mozell, P.R. Sheehe and S.W. Swieck, SUNY, Upstate Medical Center; and D.G. Hornung, St. Lawrence University.
AN ELECTROPHYSIOLOGICAL PARAMETRIC STUDY OF THE STIMULATION VARIABLES AFFECTING THE OLFACTORY NERVE RESPONSE.

G.D. Adamek, R.G. Mair and R.C. Gesteland, Northwestern University.
EOG'S ARE STIMULUS SPECIFIC DURING CILIARY GROWTH.

S.J. Kleene and R.C. Gesteland, Northwestern University.
SPECIFICITIES OF OLFACTORY RECEPTORS.

R.G. Mair and R.C. Gesteland, Northwestern University.
WITHOUT INTERNEURONS, MITRAL CELLS ECHO RECEPTOR CELLS.

J. Maruniak, W.L. Silver and D.G. Moulton, University of Pennsylvania and VA Medical Center.
OLFACTORY RESPONSES TO BLOOD-BORNE ODORANTS.

G. Hellekant, University of Wisconsin.
BEHAVIORAL AND NEUROPHYSIOLOGICAL STUDY OF MIRACULIN IN MACACA MULATTA.

Friday Afternoon, April 24

1:00-2:00 PM — General Business Meeting of the Association, Hernando-DeSota South

Saturday Morning, April 25

8:00-10:00 AM — Session VII, Animal Psychophysics, Sara-DeSoto North and South

Chair: J. Smith
Speakers: G. Nowlis , A. Granda, J. Walker, B. Wenzel, R. Morrison

This symposium will focus on the procedures involved with evaluating the chemosensory capabilities of different animal species.

10:00-10:30 AM — Coffee Break

10:30 AM-12:30 PM — Session VIII Chair: R. Costanzo, Sara-DeSoto North and South

R. Chase, McGill University.
TROPOTACTIC ORIENTATION TO ODORS BY TERRESTRIAL SNAILS.

J.R. Mason, Monell Chemical Senses Center; and T.H. Morton, Brandeis University.
SELECTIVE, REVERSIBLE ANOSMIA IN TIGER SALAMANDERS (AMBYSTOMA TIGRINUM) INDUCED BY CHEMICAL TREATMENT OF THE OLFACTORY EPITHELIUM.

Session VIII, Continued

C.J. Wysocki, J. Nyby, G. Whitney, S. Erisman, R. Bernhard and D. Crouthamel, Monell Chemical Senses Center, University of Pennsylvania, Lehigh University, Florida State University.
THE INFLUENCE OF CHEMOSENSORY SYSTEMS AND SOCIAL EXPERIENCE UPON MALE MOUSE COURTSHIP VOCALIZATIONS.

K. Yamazaki, M. Yamaguchi and G. Beuchamp, Monell Chemical Senses Center; J. Bard and E. Boyse, Memorial Sloan-Kettering Cancer Center.
CHEMOPERCEPTION OF MAJOR HISTOCOMPATIBILITY (MHC) TYPES AMONG MICE.

R.F. Reidinger, Jr., and G.K. Beuchamp, Monell Chemical Senses Center.
CONDITIONED AVERSION TO A TASTE PERCEIVED WHILE GROOMING.

J.J. Braun, Arizona State University.
GUSTATORY NEOCORTEX: FUNCTIONAL COMMONALITIES WITH OTHER SENSORY NEOCORTICAL AREAS.

J.A. DeSimone, G.L. Heck and S.K. DeSimone, MCV/VCU.
ACTIVE ION TRANSPORT ACROSS THE CANINE LINGUAL EPITHELIUM IN VITRO.

Saturday Afternoon, April 25

12:30-2:00 PM — Givaudan Luncheon, Poolside

Menu: Minestrone; Carved to order, Ham, Roast Beef, Hot Corned Beef; French Bread; Condiments; Lettuce; Tomatoes; Potato Salad; Cole Slaw and Assorted Pastries and Cakes. Tickets $11.00 (Graduate Students $5.50) will be on sale at the AChemS registration desk.

In the event of inclement weather the luncheon and lecture will be postponed 1.5 hours to allow the Hotel to prepare an indoor site.

2:00-3:00 PM — The Third Annual Givaudan Lecture, Sara-DeSoto North and South

This year's speaker is Dr. Johanna Dwyer, Director of the Frances Stearn Nutrition Center of Tufts University. Her lecture is entitled "Nutrition and Chemoreception: An Important Connection".

Saturday Evening, April 25

6:00-7:30 PM — Information Retrieval Incorporated, Reception, Hernando-DeSoto South

Information Retrieval Incorporated, publishers of Chemical Senses, Chemoreception Abstracts, Chemoreception Titles and the ECRO Symposium Series, will host a reception for the membership. During the reception a demonstration of an on-line computer search of Chemoreception Abstracts will be presented.

Saturday Evening, April 25

7:30-
11:00 PM Session IX, Poster Presentations, Hernando-DeSoto North

1. B.W. Ache and R.A. Gleeson, Whitney Marine Laboratory, University of Florida.
AN APPROACH TO THE FOCAL PRESENTATION OF CHEMICAL STIMULI.

2. M. Meredith and D.M. Marques, The Worcester Foundation for Experimental Biology.
PATTERNED ACTIVITY IN A COMPUTER SIMULATION OF THE ANATOMICAL CONNECTIONS IN THE OLFACTORY BULB.

3. J.G. Brand and J.L. Rabinowitz, Monell Chemical Senses Center.
ANALYSIS OF POLAR AND NEUTRAL LIPIDS FROM TASTE AND NON-TASTE EPITHELIAL TISSUES FROM ADULT STEER AND CALF TONGUE.

4. A.M. Calvino, Universidad de Buenos Aires.
EFFECTS OF TEMPERATURE ON GUSTATORY PERSISTENCE.

5. F.A. Catalanotto, M.E. Frank and R.J. Contreras, University of Connecticut Health Center and Yale University.
COMPARING EFFECTS OF ZINC DEPRIVATION, SODIUM DEPRIVATION AND DESALIVATION ON TASTE RESPONSES OF THE CHORDA TYMPANI.

6. M.M. Chan, New York University; J.G. Brand, D.E. Ingle and M.R. Kare, Monell Chemical Senses Center.
INFLUENCE OF DIETARY IRON DEFICIENCY ON TASTE PREFERENCE AND FLUID INTAKE IN GROWING RATS.

7. J.A. DeSimone, G.L. Heck, S.K. DeSimone, Medical College of Virginia; L.M. Bartoshuk and E. Bradley, Pierce Foundation.
PHYSICAL AND PSYCHOPHYSICAL PROPERTIES OF SURFACE ACTIVE TASTE MODIFIERS.

8. D.L. Director and R.C. Gesteland, Northwestern University.
MICROCOMPUTER ARCHITECTURE FOR CAPTURING ACTION POTENTIAL WAVEFORMS WITHOUT AVERAGING.

9. B. Eskenazi, K. Friend, W.S. Cain, E. Lipsitt, M. Rabin and R. Novelly, John B. Pierce Foundation Laboratory, West Haven VA Hospital and Yale University.
OLFACTORY INFORMATION PROCESSING IN TEMPORAL LOBECTOMIZED PATIENTS.

10. J.F. Gent and L.M. Bartoshuk, John B. Pierce Foundation Laboratory.
MAGNITUDE MATCHING OF SWEET TASTE: INDIVIDUAL DIFFERENCES.

11. I.A. Fities and G.A. Monti Graziadei, Florida State University.
SURVIVAL AND TURNOVER OF THE OLFACTORY NEURONS AFTER REMOVAL OF THEIR TARGET.

12. M.S. Herness, Florida State University.
THE ANION'S EFFECT IN SALTY ELECTRIC TASTE.

13. P.B. Johnsen and J.L. Wellington, Monell Chemical Senses Center.
CHEMICAL COMMUNICATION IN CROCODILIANS.

14. F. Ferrell, J.E. Knight, and C.L. Keen, University of California.
TASTE PREFERENCE FOR HCL SOLUTION IN RATS WITH DIETARY INDUCED COPPER TOXICOSIS UNACCOMPANIED BY ZINC DEFICIENCY.

Session IX Continued

15. D.H. Krestel, Purdue Univesity.
CANINE BEHAVIORAL RESPONSE TO URINE.

16. D. Lancet, C.A. Greer, G.M. Shepherd, and J.S. Kauer, Yale University School of Medicine.
ODOR ELICITED PATTERNS OF 2-DEOXYGLUCOSE UPTAKE IN THE SALAMANDER OLFACTORY PATHWAY USING HIGH RESOLUTION AUTORADIOGRAPHY.

17. A. Mackay-Sim and D.G. Moulton, Univesity of Pennsylvania and V.A. Medical Center.
ODORANT SPECIFIC PATTERNS OF DIFFERENTIAL SENSITIVITY INHERENT IN THE SALAMANDER OLFACTORY EPITHELIUM.

18. M.A. Marrazzi, J.F. Holliday, J.L. Luby and K.W. Fish, Wayne State University School of Medicine.
A CENTRAL NERVOUS SYSTEM GLUCOSTAT INVOLVED IN INSULIN HYPOGLYCEMIC CONVULSIONS?

19. J.R. Mason, Monell Chemical Senses Center; and T.H. Morton, Brandeis Univ.
SELECTIVE, REVERSIBLE ANOSMIA IN TIGER SALAMANDERS (AMBYSTOMA TIGRINUM) INDUCED BY CHEMICAL TREATMENT OF THE OLFACTORY EPITHELIUM.

20. C.Murphy, Monell Chemical Senses Center.
EFFECTS OF AGING ON CHEMOSENSORY PERCEPTION OF BLENDED FOODS.

21. D.M. Norris, University of Wisconsin.
FLAVONOID STIMULANTS OF INSECT BEHAVIOR.

22. M.C. Nowycky, N. Halasz and G.M. Shepherd, Yale University School of Medicine.
STUDIES OF DOPAMINE AS A NEUROTRANSMITTER IN THE TURTLE OLFACTORY BULB.

23. R.P. Byrd, Jr., and J. Caprio, Louisiana State University.
OLFACTORY CROSS ADAPTATION BETWEEN AMINO ACIDS IN THE CATFISH.

24. D.W. Criswell and R. Schafer, North Texas State University.
ONLY ESTERS PROTECT THE OLFACTORY MUCOSA FROM INHIBITION BY THE VAPOROUS ALKYLATING AGENT, ETHYL BROMOACETATE.

25. S.P. Schneider and J.W. Scott, Emory University.
DISCRIMINATION BETWEEN MITRAL AND TUFTED CELL EXTRACELLULAR SPIKES IN THE RAT OLFACTORY BULB BY ANTIDROMIC ACTIVATION.

26. J.S. Schwartzbaum and C.H. Block, University of Rochester.
UNIT ELECTROPHYSIOLOGY OF TASTE-MEDIATED BEHAVIOR IN THE PARABRACHIAL REGION OF THE RABBIT.

27. B.M. Slotnick and F.W. Schoonover, The American University.
EFFECTS OF UNILATERAL BULBECTOMY IN RATS ON OLFACTORY THRESHOLDS.

28. M.E. Frank and D.V. Smith, University of Connecticut Health Center and University of Wyoming.
TYPES OF TASTE NEURONS IN THE HAMSTER CHORDA TYMPANI.

29. D.A. Stevens, Clark University and U.S. Army Natick R/D Laboratories.
AGE DIFFERENCES IN THE CONTRIBUTION OF OLFACTION TO FLAVOR.

30. J.B. Travers and R. Norgren, The Rockefeller University.
INTERNEURONS PROJECTING TO MOTONEURONS INVOLVED IN INGESTION AND REJECTION.

Sunday Morning, April 26

8:30-
12:00 Noon Session X, Poster Presentations, Hernando-DeSoto North

1. B.W. Ache, University of Florida.
OLFACTORY-INDUCED CENTRAL NEURAL ACTIVITY IN THE SPINY LOBSTER.

2. C.H. Block and J.S. Schwartzbaum, University of Rochester.
EFFERENT CONNECTIONS OF THE PARABRACHIAL AREA IN THE RABBIT.

3. D. Brown and J. Ewen, Florida State University.
TASTE PREFERENCES FOR SUGARS IN THE DOG.

4. P. Cancalon, Florida State University.
REGENERATION OF THE CATFISH OLFACTORY CELLS AFTER VARIOUS TYPES OF INJURY.

5. C.H. Cearley, S.N. Kogge and F.E. Hanson, University of Maryland.
CHARACTERIZATION OF A BLOWFLY CHEMORECEPTOR USING COMPUTER ANALYSIS.

6. J.E. Cometto-Muniz, CONICET-Fac. Medicina, UBA, Buenos Aires; and J.B. Pierce Foundation Laboratory.
ODOR, TASTE AND FLAVOR PERCEPTION OF SOME FLAVORING AGENTS.

7. P.M. DeLorenzo, University of Rochester.
TIME COURSE AS A DISCRIMINATION OF TASTE QUALITY IN PARABRACHIAL UNITS OF THE RABBIT.

8. J.G. Kostelc, G. Epple and A.B. Smith, III, Monell Chemical Senses Center.
GC/MS ANALYSIS OF MARMOSET SCENT MARKS.

9. H.W. Harper, Rockefeller University; M.E. Frank, University of Connecticut Health Center; R.J. Contreras, Yale University.
ORIGIN OF THE PHASIC COMPONENT OF TASTE RESPONSES.

10. R.A. Gleeson, Monell Chemical Senses Center and C.V. Whitney Marine Lab.
LOCALIZATION AND MORPHOLOGY OF THE SENSORY STRUCTURES MEDIATING PHEROMONE RECEPTION IN THE BLUE CRAB.

11. K.A. Hamilton and K.A. Linberg, University of California.
STRUCTURE OF AN UNUSUAL CONTACT CHEMOSENSORY SETA IN THE KELP CRAB, PUGETTIA PRODUCTA (RANDALL).

12. W. Jakinovich, Jr., CUNY, Lehman College.
GUSTATORY RESPONSE OF THE GERBIL TO METHYL α-D-ALLOPYRANOSIDE.

13. R.E. Johnston, Cornell University.
PITUITARY CONTROL OF ODOR ELICITED LH AND SNIFFING RESPONSES IN MALE MICE.

14. R.B. Koch and H. Rossi, Mississippi State University.
ODORANT RESPONSES OF Na^+-K^+ ATPASE ACTIVITY BY PREPARATIONS FROM PAIRED TURBINALS OF RAT OLFACTORY TISSUE.

15. D. Lancet, C.A. Greer and G.M. Shepherd, Yale University School of Med.
HIGH RESOLUTION 2-DEOXYGLUCOSE AUTORADIOGRAPHY IN THE OLFACTORY BULB.

Session X Continued

16. A. Kehr and M. Levandowsky, Pace University.
ACCUMULATION AND DISPERSAL OF TETRAHYMENA (CILIATA) IN RESPONSE TO AROMATIC AND INDOLE AMINES.

17. R.W. Mankin and M.S. Mayer, USDA-SEA-Agricultural Research Laboratory.
THE QUANTIFICATION OF RELATIONSHIPS AMONG OLFACTORY STIMULUS-RESPONSE PARAMETERS.

18. T. Marui, Kagoshima University and Gifu College.
CENTRAL GUSTATORY PROJECTIONS IN THE CARP.

19. D.G. Mook and C.L. Wall, University of Virginia.
CONTROL OF SWEET SOLUTION MEALS IN THE RAT: HOW SWEET IT IS, NOT HOW GOOD IT IS.

20. M.H. Nathan and D.G. Moulton, V.A. Medical Center and Univ. of Pennsylvania.
ODORANT RELATED 2-DEOXYGLUCOSE UPTAKE IN THE SALAMANDER OLFACTORY EPITHELIUM.

21. G.H. Nowlis, Rockefeller University.
ON THE HAMSTER'S RESPONSE TO TASTE MIXTURES.

22. G. Preti, C.A. Kiddy, H.J. Lawley and J.G. Kostelc, Monell Chemical Senses Center; U. Pennsylvania; USDA.
CHANGES IN VOLATILES OF BOVINE VAGINAL FLUIDS IN RELATION TO ESTRUS.

23. B. Sandick and A.V. Cardello, US Army Natick R/D Laboratories.
FUNGIFORM VS. CIRCUMVALLATE PAPILLAE: IDENTIFICATION OF TASTANTS AND PSYCHOPHYSICAL EXPONENTS.

24. J. Schlein and G. Leonardi, York College.
A STRUCTURAL STUDY OF A PROPOSED CHEMORECEPTOR ON THE GILLS OF LIMULUS POLYPHEMUS.

25. F.W. Schoonover and B.M. Slotnick, The American University.
NO EVIDENCE FOR FUNCTIONAL DEFICITS FROM EARLY X-IRRADIATION OF RAT OLFACTORY BULBS.

26. W.L. Silver and D.G. Moulton, VA Medical Center and University of Pennsylvania School of Medicine.
ODOR-ELICITED RESPONSES FROM THE RAT TRIGEMINAL NERVE.

27. B.M. Slotnick, The American University.
ABSOLUTE OLFACTORY THRESHOLDS IN RATS AND HUMANS.

28. A.C. Spector, J.C. Smith and G.R. Hollander, Florida State University.
THE EFFECTS OF VARYING BOTH US INTENSITY AND CS PREEXPOSURE LEVELS IN TASTE AVERSION CONDITIONING.

29. J. Teeter, Monell Chemical Senses Center.
EVIDENCE FOR CHEMICAL COMMUNICATION IN SEA LAMPREYS.

30. V. Vydec, University of Delaware College of Marine Studies.
FUNCTIONAL SEPARATION OF TASTE AND NON-TASTE BEHAVIORS IN OYSTER DRILLS.

The Association for Chemoreception Sciences
Executive Committee 1980-81

Executive Chairperson	Linda Bartoshuk
Executive Chairperson, Past	Maxwell Mozell
Executive Chairperson, Elect.	Gordon Shepherd
Secretary	Rose Marie Pangborn
Treasurer	Thomas Getchell
Membership	James Smith
Program	Robert O'Connell
Councilors	Joseph Brand, John DeSimone

Program Committee 1980-81

Robert O'Connell (Chairperson); B. Ache, G. Burd, J. Caprio, R. Gesteland and M. Mayer.

The Association gratefully acknowledge the generous financial support provided by its corporate members:

The General Foods Corporation
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IN MEMORIAM

The Association notes with sadness the untimely death of Dr. David G. Moulton. Dr. Moulton was one of the pioneers in olfactory research and is responsible for many advances in our understanding of olfactory morphology, physiology and psychophysics.

ABSTRACTS OF VOLUNTEER PRESENTATIONS

OLFACTORY-INDUCED CENTRAL NEURAL ACTIVITY IN THE SPINY LOBSTER
Barry W. Ache, Whitney Marine Laboratory, Univ. of Florida.

The large decapod crustacea possess a well-developed olfactory sense. Receptors borne on the first antennas (antennules) synapse in glomerular neuropile in the deutocerebrum of the supraesophageal ganglion (brain) with processes of olfactory interneurons. An excised, perfused anterior-end preparation is described that permits direct microelectrode access to the olfactory neuropile and axons of the olfactory interneurons while maintaining the peripheral receptors in viable condition. This preparation is used to characterize neural activity descending from the brain to lower motor centers that is elicited by chemical stimulation of the olfactory receptors.

Interneurons at this level of the olfactory pathway are all multimodal and exhibit at least 3 types of response to complex stimulus mixtures (e.g., crab muscle extract); (1) excitation and (2) inhibition of spontaneously active units and (3) excitation of otherwise silent units. Chemosensory fields of all three types of units are primarily bilateral. Response intensities vary with stimulus concentration and duration. The responses show varying degrees of lability to repetitive stimulation of the receptors. The degree of lability does not correlate with receptor type. These interneurons are considered as possible components of triggering circuits for reflexive movements elicited by antennular chemostimulation as described by Maynard and Dingle (Z. vergl. Physiol. 46: 515-540, 1963).

AN APPROACH TO THE FOCAL PRESENTATION OF CHEMICAL STIMULI.
Barry W. Ache and Richard A. Gleeson. Whitney Marine Laboratory, Univ. of Florida.

Direct application of chemical stimuli to the chemosensitive membrane enhances the analysis of chemoreceptor output. This is particularly true, for example, in aquatic arthropods where previous studies (Schmitt & Ache, Science 205: 204, 1979) have shown the tufted arrangement of chemosensory sensilla affects the access of stimulants to individual receptor-containing sensilla. An olfactometer is described that presents reproducible, temporally-discrete pulses of stimuli to individual chemosensory sensilla. The device is based on standard pressure injection technique; pulses of compressed air eject volumes of stimulant from 10 μm diameter glass micropipettes. Volumes dispensed are linear with time and pressure, allowing for easy system calibration. Six concentrically-mounted pipettes allow focal presentation of up to six different stimuli or concentrations. A six-way, high-pressure rotary valve determines which stimulant is ejected. The system is simple to construct, introduces no electrical or mechanical noise into nearby recording electrodes, and requires only minimal amounts of stimulant. This later feature should be important when using synthesized pheromones or other expensive stimulus compounds. The system should be readily adaptable to different receptor preparations.

EOG'S ARE STIMULUS SPECIFIC DURING CILIARY GROWTH.
Gloria D. Adamek, Robert G. Mair and Robert C. Gesteland. Northwestern University, Evanston, IL 60201

Olfactory cilia transduce odorants. Frog olfactory neurons bear two types of cilia. Young neurons bear short (20 - 50 um) motile cilia. Mature cells bear longer (up to 200 um) immotile cilia. Perfusion of the olfactory sac with 0.1M $ZnSO_4$ ablates the epithelium. The EOG is first recordable 12 days after treatment, which is when regenerated olfactory cilia are first seen. Through day 29, there is a linear relation between the rate of EOG recovery and the time after treatment. However, the slope of the recovery function is markedly different for different odorous chemicals. No obvious relation is evident after this time. Instead, there is an abrupt jump over a short period, bringing the EOG amplitude for each substance to within 10% of the value measured in a mature nose with no $ZnSO_4$ exposure. Immature cells bearing short cilia account for most of the EOG current. Treatment of the olfactory epithelium with 0.025% Triton X-100 cleaves cilia near the apical knob. 6 hours after treatment, the EOG amplitude is reduced by more than 50%. EOG amplitude increases in a linear fashion during the following 18 hours, attaining 100% of the control value when the longest cilia measure about 35 um. Therefore, the majority of the receptor sites contributing to EOG generation are located on the more recently elaborated ciliary surface. EOG's for different odors increase at different rates during ciliary regrowth. These rates are strongly correlated with those seen during recovery after $ZnSO_4$ treatment. The recovery rates are not simply related to access factors such as water or lipid solubility.

These experiments support the idea that receptors for different substances are independent and are synthesised and incorporated into the ciliary membrane at different rates.

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CHEMICAL COMMUNICATION AND REPRODUCTIVE BEHAVIOR IN THE SEA HARE APLYSIA BRASILIANA (MOLLUSCA: OPISTOBRANCHIA).
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Marine gastropods of the genus Aplysia are widely used as models in neurobiology due to their giant neurons. However, few studies have focused on Aplysia ethology. This paper examines chemical communication in A. brasiliana in which a pheromone produced during egg-laying attracts conspecifics, serving to maintain breeding aggregations.

As simultaneous hermaphrodities, Aplysia have an anteriorly-placed penis and dorsal common genital aperature which allow copulation as sperm donors ("males"), recipients ("females"), or both at once. Although Aplysia can assume either or both sex roles, specific animals exhibit sex role preferences. Since male and female sex steroids are present, mass spectrophotometry of hemolymph samples revealed that "males" (copulate as male 80% of the time) had more testosterone than 17-B-estradiol; "females" had more 17-B-estradiol than testosterone; and "intersexes" (male = female copulatory frequency) had either equal amounts of the two steroids or no detectable quantities.

While some Aplysia lay large egg masses almost daily, others lay small ones infrequently. Sex roles and egg-laying were correlated: "females" are egg-layers (EL), "males" are non egg-layers (NEL). Ovotestes of "females" are filled with eggs, while those of "males" have few. Injections of 17-B-estradiol into Aplysia with no sex role preference resulted in "females", while injections into "males" resulted in "intersexes". Since testosterone injections produced no sex role changes, 17-B-estradiol may control sex role and egg production.

Egg-laying and aggregation are linked in that EL are rarely found alone; isolating animals results in increased egg-laying; and an EL is found at the base of most aggregations. In test aquaria, an EL elicits aggregation whereas eggs alone or NEL do not. These data suggest a pheromone released during egg-laying attracts conspecifics. Of extracts from seven different glands, only the accessory genital mass elicited aggregation.

THE "INFORMATION CURRENT" IN DECAPOD CRUSTACEA. Jelle Atema. Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA 02543

One of the first behavioral responses exhibited by various decapod crustacea (lobsters, crabs, crayfishes) to the presence of chemical stimuli is a burst of activity of the exopodites of the three pairs of maxillipeds. These relatively large appendages act together in a stereotyped (up to 10 Hz) rhythm and generate an external water current. In contrast, the gill bailers or scaphognatites (exopodites of the second maxillae) are located inside the gill chamber and serve to generate the slowly (1 Hz) pulsating gill current. Whereas chemical food stimuli have little effect on gill bailer activity, both food odors and social chemical stimuli activate the maxilliped exopodites. In the context of lobster courtship behavior, the male's exopodites are activated by water surrounding a freshly molted female. In agonistic encounters the exopodites are often active as well. Dye studies showed that the maxilliped exopodites draw water from all around the animal, concentrate it into a small area directly below them, suck it up in a vertical colum, and expel it frontally with great speed in a horizontal jet 20-30° to either side of the animal's medial axis. The two sides can function independently.

The first two pairs of walking legs with their sensitive chemoreceptors and the chemoreceptive third maxillipeds themselves (endopodites) are often placed at the base of this suction column. The antennules with their olfactory aesthetasc receptor hairs can be moved downward and are thus placed in the exopodite-generated expelling current. These behavioral responses would expose the three major chemoreceptive appendages presently known in decapod crustacea to chemical stimuli from all around the animal. The exopodite current could also serve to broadcast chemical stimuli, particularly urine products, since the decapod excretory pores are located directly above the exopodite fan on the basal segment of the antennae. Gill effluent would likewise be blown away by this current. It is proposed that the maxilliped exopodites serve as a fan to generate an "information current", both for broadcasting and receiving chemical stimuli.

POSTNATAL INGESTIVE EXPERIENCE AND SWEET TASTE PREFERENCE IN HUMAN INFANTS. Gary K. Beauchamp. Monell Chemical Senses Center, and University of Pennsylvania, 3500 Market St., Philadelphia, PA.

While it is known that sucrose solutions are avidly consumed by newborn infants, factors influencing responses to sweetened liquids in older infants and children have not been explored. Results from a longitudinal study suggest that feeding practices of mothers modulate preferences for sweetened solutions.

Infants 1 to 4 days old (n=199) were presented solutions of sucrose (0.2 and 0.6 M) and sterile water for a total of 2 min each on 2 consecutive days. Volume ingested was recorded. Subjects were retested twice at 6 months of age (n=131) and at 2 years of age (n=91). At both 6 months and 2 years of age, 7-day dietary records and a questionnaire concerning feeding habits were obtained.

From dietary records obtained at 6 months of age, it was found that many of the mothers regularly fed their infants sweetened water (tap water sweetened with sucrose, honey, or Karo syrup) as part of their normal regimen. Intake of sucrose solutions by these infants was compared with intake of infants whose mothers did not report feeding them sweetened water. At birth, these two groups ingested equal amounts of sucrose solution and water. However, at six months of age, infants fed sweetened water ingested more sucrose solution but not more water than infants not being fed sweetened water. The relative preference for sucrose compared with water declined between birth and 6 months of age in the group not fed sweetened water whereas it was maintained at approximately the same level as at birth in the group fed sweetened water.

At 2 years of age, virtually no child was still being fed sweetened water. Children at this age were classed into groups based on whether they had been fed sweetened water and, if so, for how many months. Those infants who had never been fed sweetened water ingested less sucrose solution but not less water than those infants who had been fed sweetened water.

These data demonstrate a correlation between mothers' feeding practices and infants' and childrens' responses on brief presentation taste preference tests. The initial (at birth) similarity of the groups suggests but does not prove a causal link. It is hypothesized that at birth, sucrose solutions are not novel because taste experience is limited and there is little with which to compare the solutions. The inherent pleasantness of the sweet taste is paramount. However, for older infants not fed sweetened water during development, sucrose solutions are novel and intake is depressed. (Supported by USDA grant #59-32U4-03).

EFFERENT CONNECTIONS OF THE PARABRACHIAL AREA IN THE RABBIT. Christine H. Block and Jerome S.Schwartzbaum. University of Rochester, Department of Psychology, Rochester, NY 14627.

The efferent projection systems of the parabrachial area (PBA) in the rabbit were studied utilizing the ^{3}H-amino acid autoradiographic technique. After gustatory regions were electrophysiologically defined in the PBA , ^{3}H-leucine (0.2-0.3μl, 20 Ci/μl) was introduced into these taste areas by a pressure injection. Survival times varied from 3-5 days. Analysis of the data revealed that cells located in the medial aspect of the PBA projected rostrally through the central tegmental tract and reticular formation with some fibers terminating in the caudal aspect of the ventromedial thalamic nucleus. Other fibers coursed ventro-laterally in the subthalamic area to the caudo-lateral aspect of the lateral hypothalamus. Injections more caudal in the PBA resulted in a similar projection pathway as well as extended rostral labelling of the dorsomedial aspect of the central nucleus of the amygdala and the substantia innominata.

In an ancillary study, gustatory units in the PBA were electrically stimulated in anesthetized rabbits. (150 μ A) while recording evoked responses in the substantia innominata and amygdala. Ninety units were located by this method which had latencies ranging between 9-90 msec. However, only a small percentage of these evoked units were responsive to the four tastants (saline, acid, sucrose, quinine).

MOLECULAR STRUCTURE AND OLFACTIVE PROPERTIES.
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We studied the odor qualities of over 300 aromatic chemicals, using 30 different odor aspects. The odor aspects were quantified by an expert panel on a scale from 0 to 9.

Principal component analysis (Varimax rotation) of the odor aspects as variables gave 15 factors with the most relevant combinations. Using their factor scores the odorants could be classified into 8 groups of 80 products, with a reasonable degree of overlap. Subsequently, each of these groups was submitted to factor analysis (inverted data matrix) with the odorants as variables and the aspects as cases. This afforded 14 clusters of compounds, having very similar aspect patterns within each cluster. Quantitative structure-activity relationships have been derived by correlating the ten strengths of each chemical compound within a cluster with the compounds' molecular structure features and physicochemical parameters, such as molecular weights and partition coefficients.

RESPONSES OF TARSAL CHEMORECEPTORS OF THE APPLE MAGGOT TO OVIPOSITION DETERRENT PHEROMONE. Elizabeth Bowdan. Department of Zoology, University of Massachusetts, Amherst, Massachusetts 01003.

The apple maggot, Rhagoletis pomonella, lays a single egg in a fruit and then circles the fruit dragging her ovipositor. During this process she lays a trail of pheromone which deters subsequent females from laying eggs (Prokopy, 1972). Ablation studies demonstrated that the pheromone exerted its effect mostly through the prothoracic tarsi (Prokopy and Spatcher, 1977). Preliminary electrophysiological examination of the tarsal chemosensory hairs showed that the D hairs of the 2nd, 3rd, and 4th tarsomeres were especially sensitive to the pheromone (Crnjar, in prep.). More detailed examination of the response shows that both spike height and frequency are correlated with pheromone concentration. The response is phasic-tonic with the tonic portion being extremely slow to adapt. In fact it may not. Some sensilla were active throughout 5 minutes of stimulation. Disadaptation is very rapid. The sensilla may give a response which is 50% of the response to the first stimulation (in terms of the numbers of spikes during the first second of stimulation) after an inter-stimulus-interval of only 2 seconds.

ANALYSIS OF POLAR AND NEUTRAL LIPIDS FROM TASTE AND NON-TASTE EPITHELIAL TISSUES FROM ADULT STEER AND CALF TONGUE. Joseph G. Brand and Joseph L. Rabinowitz. Monell Chemical Senses Center, 3500 Market St., and Veterans Administration Medical Center, Univ. of Pennsylvania, Philadelphia, PA 19104

It has been hypothesized that the initial receptive event for salty and sour is interaction of the stimulus with the lipid of the plasma membrane of taste receptor cells. The question as to whether the lipid distribution of the taste receptor cell area is unique has not been directly addressed since previous studies have analyzed lipid from entire circumvallate papilla (CVP). Only the lateral epidermal boarder of the bovine CVP contains taste buds. We have surgically divided the CVP into three portions: the taste bud-containg lateral epidermis, the non-taste bud dorsal epidermis, and the non-taste bud dermal core. Epidermal pieces from other non-taste areas of the tongue were also analyzed. Total lipid and fatty acid analysis was carried out as described by Rabinowitz et al., Clin. Orthop. 143, 260, 1979, using TLC and GLC. An approximate 50/50 distribution of neutral to polar lipids was observed for all tissues. The CVP taste epidermis contains no unusual amounts of the phospholipids phosphatidyl cholines (8.5%), phosphatidyl serines (4.0%), and phosphatidyl inositols (3.2%). It also contains about 15% cholesterol-cholesterol ester. This distribution of lipids was not different from several types of non-taste epidermis. In all tongue epidermis the amount of methyl esters was high(around 5%). The fatty acid profiles of the CVP dermal core (non-taste) showed a pattern of carbon chains of higher number than those of CVP taste epidermis and two other non-taste epidermal controls. Calf CVP taste epidermis appeared to have less cholesterol plus cholesterol esters and less cardiolipin plus phosphatidic acid than the adult steer CVP taste epidermis.

GUSTATORY NEOCORTEX: FUNCTIONAL COMMONALITIES WITH OTHER SENSORY NEOCORTICAL AREAS. J. Jay Braun. Arizona State University, Department of Psychology Tempe, AZ 85281

The results of several studies which characterize the nature of involvement of gustatory neocortex (GN) in associative taste processes, particularly memory, will be summarized and related to comparable studies of other sensory neocortical areas.

Ablation of gustatory neocortex in rats disrupts associative taste processes without permanently affecting detectability thresholds for taste stimuli. Preoperatively instated taste avoidance habits are lost following GN ablation, but they can be reacquired. The loss is specific to GN ablation because control lesions of other neocortical areas have no effect on the taste habits. In addition, the memory loss following GN ablation is specific to taste stimuli because learned odor habits are retained by by the same operated rats that show complete memory losses of equivalent taste habits. Other experimental observations of discrimination and generalization changes in the acquisition and retention of taste habits reinforce the view that the GN has the same kind of involvement in the details of associative taste processes as other sensory neocortical areas have in learning and memory processes related to their relevant sensory cues. However, in contrast to the results of certain studies of visual, auditory and somatosensory neocortex, sequential-unilateral ablation of GN does not appear to facilitate retention of preoperatively instated taste habits.

DISCRIMINATION BETWEEN DISTANCE CHEMOATTRACTANTS IN OYSTER DRILLS. Betsy Brown, Daniel Rittschof, Leslie Williams, and Melbourne Carriker, College of Marine Studies, University of Delaware, Lewes, DE 19958

The ability of nascent oyster drills, Urosalpinx cinerea cinerea, to discriminate between distance chemoattractants was tested using a circular, flow-through choice chamber, into which four stimulus portals opened via obliquely angled tunnels. Water which contained stimulus passed through a flow meter, into one of the choice chamber portals, through the central holding well and out a hole in the well base. To begin an experiment, at least 100 unfed, recently hatched drills were placed in the well. After a defined time period, drills which had climbed into each portal were counted. When drills were presented with seawater only (same flow for each portal), rheotactic response was low, increasing slightly with increases in flow rate. When seawater passed through each portal at different rates (0.5, 2.8, 8.4, and 14 ml/min), there was no difference in response.

Experiments contrasting response to seawater passing through two portals and to water from Balanus eburneus (BEW) holding tanks passing through the remaining two portals indicate drills can distinguish significantly between the two stimuli. There was a dramatic increase in response in 30 min runs over 10 min runs, while there was little difference in response between 30 and 60 min runs. When a dose response curve of BEW was run (no dilution, 1:10, 1:100, 1:1000 dilutions), drills responded significantly more to full strength BEW. This difference in responsiveness to BEW at full strength was notably higher in the discrimination assay than in assays not testing discrimination. At a flow of 14 ml/min, drills can discriminate between no dilution, 1:5, 1:10 and 1:50 dilutions of BEW; but they cannot discriminate between no dilution, 1:2.5, 1:5 and 1:10 dilutions of BEW. When flow rates were altered in dose response curve experiments, responsiveness changed. These results indicate that both flow rate and stimulus concentration influence discrimination and distance chemotaxis of oyster drills.

TASTE PREFERENCES FOR SUGARS IN THE DOG

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Taste preferences for a number of sugar solutions over water were assessed for a group of purebred adult (two-four years) beagles. During the experiment, the dogs were housed in groups of three to five in indoor-outdoor runs. Dogs were given ad lib dry food in their runs and were twenty-three hour water deprived at the beginning of each session. At the beginning of this experiment, the dogs had already acquired a great deal of experience with sweetners.

Sugars tested were sucrose, fructose, glucose, galactose, xylose and maltose. The percent preference for a molar concentration of the sugar solution over water was computed using the formula:

$$\frac{\text{grams sugar solution consumed}}{\text{grams sugar solution + grams water consumed}}$$

Each point was repeated several times. For each sugar a concentration curve was plotted. Degrees of preference were defined by the criteria of Goatcher and Church.[1] At very low concentrations dogs did not prefer the sugar solutions to water. At higher concentrations, however, sugar solutions were invariably preferred to water. Responses to the various sugars differed markedly, however. Fructose, glutose and sucrose were highly preferred (greater than eighty percent) even at intermediate (.3M) concentration. Only a moderate preference was shown for the other sugars.

1. Goatcher and Church. 1970. J. Animal Sci. 30(5) 777-783

OLFACTORY CROSS-ADAPTATION BETWEEN AMINO ACIDS IN THE CATFISH.

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Electrophysiological studies have shown that a similar spectrum of amino acids is highly stimulatory to the olfactory system of a number of fish species, suggesting a commonality of amino acid receptor mechanisms. However, with the exception of this study, specific electrophysiological information concerning the olfactory transduction mechanisms for amino acids in fish is lacking.

Cross-adaptation experiments utilizing amino acids as adapting and test stimuli provided evidence for similarities and differences in transduction mechanisms for particular amino acids dependent on stimulus molecular structure. The EOG (electro-olfactogram) was used as a method to study the effects of amino acid adaptation on the olfactory system of the channel catfish, Ictalurus punctatus. The olfactory receptors, maintaining a tonic response throughout the adapting stimulus duration, adapted slowly to continuous flows of amino acids (10^{-5}-10^{-4}M). Test amino acids (10^{-5}-10^{-3}M; 0.5 ml), with concentrations adjusted to provide equal response magnitude in the unadapted state, were injected into the adapting flow. The phasic response to the test amino acids during cross-adaption was depressed and sometimes abolished, depending on the test stimulus and concentration. Three groups of amino acid stimuli, distinguished by their respective similarity of stimulatory effectiveness under the different cross-adapting regimes, were identified. These data suggest at least three different receptor mechanisms exist which can be separated on the basis of receptor specificity: an acidic system responsive to L-aspartate and L-glutamate, a basic system responsive to L-lysine and L-arginine, and a neutral amino acid transduction mechanisms having the highest affinity for amino acids with long, unbranched and uncharged side chains (L-methionine, L-ethionine, L-norvaline, L-norleucine, L-glutamine, L-glutamic acid-γ-methyl ester).

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ODOR IDENTIFICATION: FEMALES VERSUS MALES.

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Most males claim that females possess a superior sense of smell. Tests of absolute sensitivity have generally failed to confirm this view. Hence, either the view is wrong or the tests have failed to measure a pivotal feature. Perhaps females do not have a better sense of smell but merely know the world of odors better than males. I asked 200 persons, half males and half females, to rate how well the typical person could identify the odors of 80 everyday substances, e.g., turpentine, popcorn, grape drink, lemon, wood shavings, baby powder, beer, and bologna. The two groups agreed surprisingly well ($r = +0.93$). I also asked whether females or males would identify each substance better. Again, the groups agreed well ($r = +0.95$). Both felt that females would outperform males on about two-thirds of the substances, including virtually all foods except alcoholic beverages. The groups conceded male superiority on only those substances seen as stereotypically "male", e.g., bourbon, lighter fluid, cigar butts, cigarette butts, and machine oil. Another group of persons, approximately half males and half females, actually sought to identify the substances over the course of five sessions. Females did indeed outperform males, both initially and thereafter. Females performed better even on most stereotypically "male" substances. Tests performed on another group implied that the superiority did not arise from better qualitative discrimination. The source of the difference may lie strictly in the cultural realm. In American culture, women obtain greater functional experience with odors than do men.

EFFECTS OF TEMPERATURE ON GUSTATORY PERSISTENCE.

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The effects of temperature on the time-intensity properties of taste substances was determined.

The persistence of gustatory stimuli was measured for compounds representing each of the four qualities. Three concentrations were evaluated: for citric acid 0.1%, 0.2% and 0.4%; for NaCl 1%, 2% and 4%; for sucrose 5%, 10% and 20%; for urea 2%, 4% and 8%. The solutions were sipped at each of three different temperatures: 10, 37 and 50°C. Subjects tasted each solution and judged when the sensation disappeared, then the total persistence time was recorded.

Power functions of the form $P = K.C^n$ related the perceived persistence (P in seconds) to the concentration (C in %W/V) at each temperature. The effects of temperature on persistence were different for each taste compound and both, the relative persistence and the slope of the functions showed changes.

Citric acid indicated a positive correlation between persistence and temperature, to low temperature corresponded low persistence and viceversa. In addition, when temperature raised the functions showed a lower slope. Results for NaCl showed a symmetrical opposite effect of the temperature. The persistence at high temperatures was lower than at low temperatures. The steeper functions were obtained at high temperatures. These results suggest the existence of a point where the variation of temperature does not influence the persistence of both compounds.

The results obtained with sucrose and urea were not as clear as those with citric acid and NaCl. The sweet taste of sucrose was more persistent when temperature raised, although this variation did not influence the slope value. For the bitter taste of urea maximal persistence was obtained at 50°C but there was not a clear influence of temperature on persistence.

REGENERATION OF THE CATFISH OLFACTORY CELLS AFTER VARIOUS TYPES OF INJURY. Paul Cancalon, Department of Biological Science, Florida State University, Tallahassee, FL 32306

Because of the very simple anatomical configuration of the catfish olfactory mucosa, injuries caused by chemicals have been found to be similar on the entire mucosa and easily reproducible. The segregation of the different mucosal cell types on finite areas of the lamella has allowed the precise characterization of the various types of injuries. Superficial damages limited to the removal of the olfactory and sustentacular cell processes were produced by washing the cavity with low concentration (smaller or equal to 0.1%) of Triton X-100. Following deciliation the olfactory processes grow back within 4 days. More extensive destruction was induced by washing the mucosal cavity with a solution of zinc sulfate very rapidly. This treatment is, to a large extent, concentration independent. The salt induces a specific degeneration of the olfactory receptor cells but leaves the rest of the tissue intact. The regeneration of the olfactory receptor cells occurs within a week. Very extensive damages to the mucosa were produced by rapidly washing the nasal cavity with a high concentration of detergent (equal to or higher than 1% Triton). The treatment removes a large number of cells from the lamellae which appear completely bare. Respiratory cilia reappear and a bare olfactory area can be seen at 30 days after irrigation. New olfactory receptor cells do not grow back before 50 days. At this stage only cilia bearing cells (type I) can be found. Extensive necrosis of the olfactory tissue has been produced by maintaining zinc sulfate in contact with the mucosa by sealing the nares following irrigation with the salt. These damages can be induced by concentrations of zinc sulfate producing only olfactory cell degeneration by the washing method. After a week, most of the lamellae and even the adjacent tissue (including the skin covering the olfactory cavity) have been destroyed. A possible regeneration of some olfactory receptor cells on the remaining fragments of lamella is being investigated. These different types of damages have been characterized by numerous groups on adjacent areas of the same olfactory mucosa particularly in mammal preparations. These previous studies have demonstrated the inability of the chemical to reach some areas of the mucosa, causing very superficial or no destruction at all. Conversely, extensive or permanent destructions are caused by drugs remaining on a specific mucosal area for extended periods of time. In this last case the deepest layers of the mucosa containing the olfactory germinal cells are affected rendering regeneration long or impossible. The present results show that under adequate conditions the type of damage induced by chemicals to the olfactory tissue can be precisely controlled. (NIH grant NS 14912)

COMPARING EFFECTS OF ZINC DEPRIVATION, SODIUM DEPRIVATION AND DESALIVATION ON TASTE RESPONSES OF THE CHORDA TYMPANI. Frank A. Catalanotto, Marion E. Frank & *Robert J. Contreras. Univ. Conn. Health Ctr., Farmington, CT & *Yale University, New Haven, CT.

Neural activity of the chorda tympani in response to taste solutions applied to the tongue is reduced after sodium deprivation, zinc deprivation or removal of the sublingual and submaxillary salivary glands in rats. Although in each case there is a reduction, after sodium deprivation only responses to NaCl are affected; after zinc deprivation, responses to sucrose, HCl and quinine are also affected; after desalivation, responses to all 4 test compounds are drastically affected, with NaCl's effect reduced more than in either deprivation condition and its threshold elevated.

Initial peak (phasic) responses to NaCl, affected in all 3 conditions, are reduced more at higher concentrations by sodium deprivation (40% at 1 M, 20% at .01 M), reduced equally at high and low concentrations by zinc deprivation (45%), but reduced more at lower concentrations by desalivation (90% at .01 M, 50% at 1 M). Tonic responses (measured after 10 sec of stimulation) to 5 concentrations of NaCl (.01, .03, .1, .3, 1 M) are reduced by an average 48% by desalivation, but only by 12% by zinc deprivation; after sodium deprivation, phasic and tonic responses are both reduced by an average 33%.

Behavioral observations on rats indicate that zinc deprivation and sodium deprivation result in increased intake of all suprathreshold solutions of NaCl; sodium deprivation does not affect intake of solutions of the other test compounds but zinc deprivation does. Thus, the specificity of the neural effect is paralleled in behavior. In addition, desalivation raises the behavioral threshold for NaCl and also affects intake of the other compounds which parallels neural effects of this treatment. Anatomical observations indicate that the taste pore may be elongated due to hyperkeratinization in zinc deprivation and that severe degeneration of receptor cells follows desalivation. The former may create a circuitous route for taste solutions and reduce the rate of concentration build-up at receptors; the latter may result in severe disruption of a receptor's ability to respond to active compounds.

CHARACTERIZATION OF A BLOWFLY CHEMORECEPTOR USING COMPUTER ANALYSIS. Carolyn H. Cearley, Stephen N. Kogge, Frank E. Hanson. Department of Biological Sciences, University of Maryland Baltimore County, 5401 Wilkens Avenue, Catonsville, MD 21228.

Improved electrophysiological and computer analysis techniques were used to characterize the salt receptor of a fly. All stimuli presented were of the chloride salts of Na, K, Rb, Cs and Li with seven concentrations ranging from 0.06M to 4.0M and a stimulus duration of about 5 sec. We used standard tip recording techniques on the tarsal chemoreceptors of a headless, live preparation, and with an improved amplifier we were able to obtain neural data within 8msec after onset of stimulus. In order to thoroughly describe the salt receptor, a large data base was essential and in turn necessitated the use of a computer to analyze all the data. For example, in the KCl series eight to ten chemoreceptors on eight flies were stimulated with seven concentrations of KCl plus a standard stimulus repeated 2-3 times yielding a total of 1580 stimulus-responses which contained a sum of 148000 action potentials to be analyzed. The computer program sorted the electrophysiological data into classes by means of template-matching with the template derived from the data itself. These data were then analyzed by the computer in various ways, such as: simple counting of the number of action potentials for any time segment of stimulus application, plotting of instantaneous frequency response during stimulation, and graphing of dose response curves for the entire experiment. The KCl dose-response curve yielded a response that was proportional to the logarithmic concentrations between 0.25 and 4.0M KCl. Other salts showed similar responses, but some produced a less than maximum response at the highest concentration of stimulus.

INFLUENCE OF DIETARY IRON DEFICIENCY ON TASTE PREFERENCE AND FLUID INTAKE IN GROWING RATS. Mabel M. Chan, Dept. of Home Economics & Nutrition, New York University, N.Y., N.Y. 10003, Joseph G. Brand, David E. Ingle and Morley R. Kare, Monell Chemical Senses Center, 3500 Market St., Phil., Pa. 19104.

The effect of dietary iron (ferrous sulfate) concentration on the intake of solutions of sodium saccharin, hydrochloric acid, quinine sulfate, sodium chloride, potassium chloride and lithium chloride was studied. In the first experiment, male Charles River CD weanling rats were divided into four groups and fed diets containing 0, 10, 20 or 40 ppm ferrous sulfate. Using a 48 h, two-bottle preference test, the rats fed the diet with 0 ppm (added) iron showed significantly higher preferences for sodium chloride and potassium chloride solutions compared with the other three groups. Total fluid intake also increased in rats given the unsupplemented diet but water intake was not increased when sodium was offered. Blood hemoglobin and hematocrit and body weight were lowest in the group with 0 ppm added iron, yet neither adrenal weights nor serum zinc was affected by the dietary iron levels. In the second experiment, preferences for sodium chloride, potassium chloride and lithium chloride were determined in rats fed diets with 0 or 40 ppm (added) iron. Rats fed diets with no supplemental iron displayed an elevated preference for sodium chloride and potassium chloride compared with the animals fed the supplemented diets. An aversion to lithium chloride was observed in both groups. No surface morphological analmolies nor corss-sectional anatomical abnormalities were apparent in tongues of the rats consuming the diet with no supplemental iron. It is concluded that iron deficiency may have caused an impairment in iron balance and that the deficient animals responded to this imbalance by increasing their intake of both sodium and potassium chloride.

TROPOTACTIC ORIENTATION TO ODORS BY TERRESTRIAL SNAILS. Ronald Chase. Department of Biology, McGill University, 1205 Avenue Docteur Penfield, Montreal, Quebec, Canada H3A 1B1

The paired posterior tentacles of pulmonate gastropods are essential sensory structures in the animals' locomotor orientation to distant objects. In laboratory experiments with the African snail Achatina fulica, upwind orientation (anemotaxis) depends on the animal having at least one intact posterior tentacle. Performance is not noticably affected by unilateral lesions. By contrast, when the snails are tested in the absence of winds, both posterior tentacles are required for successful orientation to a food odor source. Animals with unilateral lesions consistently turn toward the intact side. These results indicate that, in still air, snails normally compare simultaneous bilateral intensities of olfactory stimulation and then turn so as to equilibrate the two sides (chemotropotaxis). This hypothesis was confirmed in experiments with a two-chambered tentacular olfactometer. If one tentacle is sujected to an odorized airflow while the other tentacle is exposed to an equivalent flow of clean air, the snail turns toward the side of olfactory stimulation. This methodology is currently being applied to the determination of olfactory thresholds for orientation behavior.

EFFECTS OF PHARMACOLOGIC REDUCTIONS IN SALIVARY FLOW ON TASTE PERCEPTION. Carol Christensen, Mahvash Navazesh & Vernon Brightman. Monell Chemical Senses Center and School of Dental Medicine, University of Pennsylvania, Philadelphia, PA 19104.

Research on the role of salivary flow in human taste perception has focused on the study of individuals with relatively chronic xerostomia. Because saliva is essential for the integrity of the oral mucosa, the interpretation of the results is complicated by probable damage to gustatory receptors. Pharmacologic manipulation of salivary flow represents the best methodological approach because the salivary changes are short-lived. There are many medications which produce xerostomia (over 250 in the PDR) and so it becomes clinically relevant to ascertain whether xerostomia is a benign side effect or whether it leads to significant shifts in taste perception.

To date, more than 70 healthy, college-age subjects have participated in studies in which whole mouth salivary flow was measured and taste tests were administered (recognition or detection thresholds or suprathreshold scaling of the four taste qualities) both under conditions of normal and pharmacologically reduced salivary flow. In one set of studies, subjects received single oral doses of an antihistamine (Benadryl, 50 mg), an antidepressant (Elavil, 25 mg) and a placebo (lactose capsule) in separate test sessions held at weekly intervals. Elavil produced approximately a 31% and 65% reduction in unstimulated salivary flow 45 and 150 min after administration. Benadryl reduced salivary flow 32% and 43% at 45 and 150 min after administration. Pharmacologic reductions in salivary flow had no systematic or significant effects on threshold or suprathreshold judgments of "wet"(taste substances dissolved in water) or "dry" (taste solutions dried on filter papers) taste stimuli. In another set of studies, subjects received single, oral dosages of atropine (.08 or .10 mg) and a placebo in separate test sessions. Salivary flow was reduced 50% for subjects receiving the lower dose and 73% for those receiving the higher dose of atropine. Recognition thresholds and suprathreshold scaling for the four taste qualities were performed using both wet and dry taste stimuli. There was a reliable shift in recognition thresholds for wet stimuli following administration of atropine; subjects exhibited lower thresholds (were more sensitive) to aqueous taste solutions. The trend was significant with sucrose and citric acid but was also evident with quinine and NaCl (n = 9 for each taste quality). Sour thresholds for dry taste stimuli were also significantly lower when subjects received atropine. It seems likely that the effect is attributable to dilution; less saliva is available to dilute the taste stimuli and this functions to raise the effective concentration. No changes were observed in suprathreshold scaling.

ODOR, TASTE AND FLAVOR PERCEPTION OF SOME FLAVORING AGENTS. J. Enrique Cometto-Muniz.* Laboratorio de Investigaciones Sensoriales (CONICET-Fac.Medicina,UBA), Buenos Aires,Argentina and John B. Pierce Fndn. Lab., 290 Congress Ave., New Haven, CT 06519.

The sensory impact of food and food additives arises from such attributes, as odor, taste, pungency, texture, and temperature. For many substances, odor and taste form the main components of flavor. Olfaction and taste conform to somewhat different stimulus-response (psychophysical) functions. Odor intensity functions grow much less rapidly with concentration than do taste functions. A question of interest is whether the flavors of common flavorings behave more like taste functions or like odor functions. This investigation explored the growth of odor, taste, and flavor for five flavoring agents: vanillin, piperonal, benzaldehyde, natural vanilla extract, and artificial almond essence.

Between ten (10) and thirteen (13) subjects made duplicate or triplicate magnitude estimations of perceived odor, taste, or flavor intensities of a series of randomly presented concentrations for each compound (judgments made on one sensory modality for one substance in each session). Results for the two complex stimuli implied that changes in flavor with concentration reflect primarily taste over the range studied. Results for the simple stimuli implied that changes in flavor fail to follow such a uniform trend: two of the three (vanillin and benzaldehyde) resembled taste functions at high concentrations but showed a tendency to flatten at lower concentrations. The third simple stimulus (piperonal) resembled a taste function throughout the range of concentration explored. A subsequent experiment designed to explore the maximum feasible range of concentration verified and extended the results obtained with the simple chemicals. That is, vanillin and benzaldehyde yielded flat functions over a range of low concentrations and hence resembled odor functions in that range, but yielded steep functions at higher concentrations and hence resembled taste functions in that range. As before, piperonal resembled a taste function throughout the useable range. These findings imply that when a certain flavoring is used basically for its odor, small changes in its concentration are far less critical than when it is used for its taste.

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THE EFFECTS OF PRENATAL AND EARLY POSTNATAL SODIUM CHLORIDE INTAKE ON THE SALINE PREFERENCES AND BLOOD PRESSURES OF ADULT RATS. Robert J. Contreras, Therese Kosten & Anne T. Berg. Yale University, Dept. of Psychology, Box 11a Yale Station, New Haven, CT

The suggestion has been made that the preference for the taste of salt can be acquired. To date, however, there is no experimental evidence that the consumption of salt during early development is associated with a preference for salty foods later in life. We examined the relationship between the amount of sodium chloride provided to pregnant rats and their subsequent immature offspring and the offsprings' elective consumption of saline as adults.

Adult female rats consumed a diet containing either 0.12, 1 or 3 percent sodium chloride throughout pregnancy, and their offspring were continued on these diets to day 30 of life. Thereafter, all rats were maintained on the same diet containing 1 percent sodium chloride. To characterize the preferences of our experimental animals at 3 months of age, we gave the animals a two-bottle preference test between demineralized water and various molar concentrations of sodium chloride solutions.

We discovered that male rats raised on the high salt diet (3%) showed a significantly stronger preference for saline than male rats raised on either a mid or a low salt diet. This was not evident, however, for female rats. This sex difference may be accounted for, in part, by the influence of ovarian hormones on fluid intake, or by differences in susceptibility during early development to environmental change. Whatever the explanation, our observations that the amount of sodium chloride consumed early in life is related to the amount consumed electively in adulthood, suggests that a strong salt preference can be acquired, and further, establishes the importance of early experience. This process may be important inasmuch as excess sodium intake in susceptible individuals is an adverse factor to the development of hypertension.

Because of the supposed role of excess salt intake to hypertension, systolic blood pressures were recorded indirectly by tail plethysmography in some of the rats raised on a low, mid or a high salt diet. Although all the animals had been maintained on the same diet, which contained 1 percent sodium chloride, from 30 days of life to the time at which blood pressures were recorded at 160 days, our pilot data suggest that those rats raised on the high salt diet had significantly higher blood pressures than those raised on diets that contained less sodium. We are currently testing more animals to determine whether our preference and blood pressure results can be repeated.

This research was supported by NIH, NHLBI Grant HL - 24732.

6-HYDROXYDOPAMINE REDUCES OLFACTORY REACTIVITY IN RAT PUPS. Catherine A. Cornwell-Jones. Dept. of Psychology Princeton University, Princeton, NJ 08544

Infant rat pups injected systemically with 6-hydroxydopamine (6-OHDA), show reduced preference for conspecific odors, but normal acquisition of preferences for arbitrary, nonanimal odors in which they are reared from birth (Marasco, Cornwell-Jones & Sobrian, Pharmacol Biochem. Behav., 10, 1979). The present experiment examined whether olfactory reactivity--the ability to change odor preferences in response to changes in the postnatal olfactory environment (Cornwell-Jones, J. Comp. Physiol. Psych., 93, 1979)--would be impaired by neonatal 6-OHDA treatment.

On the day of birth, male Sprague-Dawley rats were injected i.p. with 100 µg/g of 6-OHDA HBr. Littermate controls were injected with vehicle only. Following injection, pups were placed in pine shavings. On postnatal day 10, pups were switched to cedar shavings, which were selected because their odor repels pine-reared rat pups 5-14 days old injected neonatally with either vehicle or 6-OHDA (Marasco et al., 1979). Odor preferences were first tested on day 13. Pups were then placed in fresh pine and given a second test on day 14. The olfactory cortex from neonatally injected adults was assayed fluorometrically for dopamine (DA) and norepinephrine (NE).

Animals were tested for 3 min in a two-choice apparatus consisting of a Plexiglas frame with a screen floor which was placed upon a two-compartment container. Fresh pine shavings were in one compartment. The other compartment contained cedar shavings on day 13, and garlic-scented pine shavings on day 14. Time spent over cedar or garlic shavings was monitored with a stopwatch.

Following 3 days in cedar, control animals prefered cedar, the scent in which they had most recently been housed, to pine. Drug-treated pups tended to prefer pine, their first, rather than their most recent environmental scent. Both treatment groups prefered unscented to garlic-scented pine odor, indicating that 6-OHDA did not impair neophobic responses to odors. Adult olfactory cortex assays indicated a 36% NE reduction in neonatally drug-treated rats, but no significant change in DA concentrations.

These findings imply that NE helps rat pups adapt to changes in the early olfactory environment, and that NE involvement in odor-guided behavior is not limited to modulating responses to conspecific odors.

SUPRATHRESHOLD TASTE SENSITIVITY: CHANGES WITH POST ADOLESCENT DEVELOPMENT. Beverly J. Cowart and Bruce J. Baum. Nat. Inst. Dental Research and Nat. Inst. Aging, NIH, Bethesda, MD 20205

It is frequently suggested that taste acuity declines with age and that this may contribute to a diminished enjoyment of food, and consequent reduction of intake, by the elderly. Thresholds have been the most commonly used indices of taste sensitivity. Although slight, age-related increases in threshold are often observed, such changes do not seem to fully account for the experience of diminished or distorted sensitivity that tends to be associated with aging. Since measures of suprathreshold sensitivity focus on sensory phenomena more akin to ordinary experience than do threshold measures, these might be expected to provide a more sensitive index of possible age-related alterations in taste perception.

Direct scaling of the perceived intensities of tastants representing each of the four basic taste qualities was performed by 51 men and 42 women ranging in age from 23 to 88 years. Stimuli were solutions of sucrose (.056 - 1.8 M), NaCl (.056 - $\frac{1}{8}$ M), citric acid (.001 - .3 M) and quinine sulfate (1.0×10^{-5} - 1.0×10^{-3} M). Seven concentrations of each tastant were presented. Subjects matched the extent of a retractable tape measure to stimulus intensity.

Responses to each tastant were treated separately. Prior to data analysis, subjects were divided into the following three age groups: < 45, 45-64, ≥ 65. Slopes of individual intensity functions were determined, and two-factor (Age x Sex) ANOVAs were performed on slope values. Two significant effects were revealed. For quinine, there was a main effect for A, reflecting a flattening of slope with aging. For NaCl, there was an A x S interaction. This reflects the fact that while the slopes of women's intensity functions tended to decline with age, those of men evidenced a significant increase in steepness after the age of 64.

The last finding was somewhat unexpected in that steeper slopes are popularly associated with greater discriminative ability and/or sensory acuity. In the present case, however, the steeper slopes of the oldest men seem to be a function of a selective loss of sensitivity to lower level salt concentrations. That is, elderly males tended to assign a greater number of "0" ratings to low NaCl concentrations than did men in either of the younger groups, while the absolute level of their mean ratings of higher concentrations fell between those given by the young and the older adult males.

ONLY ESTERS PROTECT THE OLFACTORY MUCOSA FROM INHIBITION BY THE VAPOROUS ALKYLATING AGENT, ETHYL BROMOACETATE. Darrell W. Criswell and Rollie Schafer. Department of Biological Sciences, North Texas State University, Denton, TX 76203

The vaporous alkylating agent, ethyl bromoacetate (EBA), inhibits the ability of the frog nose to respond to all odorants except aliphatic amines (Science, 210:425, 1980). As a part of this study and continuing studies with other chemically active odorants, we have attempted to produce specific inhibition using the technique first reported by Getchell and Gesteland (PNAS, 69: 1494, 1972). In this technique, the nasal mucosa is flooded with a solution containing a "protecting" odorant, then treated simultaneously with an inhibitory agent such as the protein-specific sulfhydryl reagent, N-ethyl maleimide (NEM). The expectation is that the odorant, present in excess, will occupy most of its receptor sites and protect them from interacting with the reagent.

We found that only isoamyl acetate and a few closely-related esters were capable of protecting the olfactory mucosa from the inhibitory effects of EBA applied in the vapor phase. Other odorants such as isoamyl sulfide, isoamyl alcohol, etc. did not protect. By contrast, isoamyl acetate served as a universal protector. It protected responses to a wide variety of odorants from many different odorant classes.

Getchell and Gesteland and other experimenters who have since replicated their work all used ethyl-n-butyrate or similar esters to protect. Delaleu and Holley (Chemical Senses and Flavour, 5: 205, 1980) used vaporous NEM to inhibit olfactory responses and also demonstrated protection by isoamyl acetate. Thus, there is ample evidence that some esters protect, both in the liquid and vapor phases. But why is protection conferred only by esters? Perhaps protection involves some chemical action other than simply occupying a receptor site which would otherwise react with the inhibitor.

THE EFFECT OF NON-OLFACTORY CONTEXT CUES ON ODOR IDENTIFICATION AND ON THE "TIP OF THE NOSE" STATE. Richard G. Davis. V A Medical Center, Lexington, Kentucky 40507

Odor naming can be inferior to naming of visually or aurally presented stimuli. Typically, odor research uses odorants presented without the usual context. Odorant stimuli lack the usual visual and savor system properties such as color, form, texture, temperture and the like. Even when odorants with chemical profiles that are ecologically valid (such as a piece of banana) are used, odor naming is initially poor. The studies reported here are designed to observe the role of visual context in odor identification. Context cues were color concepts, either relevant or irrelevant to the associated odorant. The context was presented as a word or as a patch of color. The odorants were controlled and presented with the Microfragrance products of the 3M Co. On each trial, subjects initially judged the familiarity of the odor, and then made an initial attempt to identify the odor. Next, the context cue was studied, and a second identification followed. The interpolated context cue could have been either relevant or irrelevant and either a word or a color. In a fifth type of trial, the interpolated context was not presented. In one study, 141 persons studied 20 odors. Each person received four trials of each of the five context types. In a second study, 165 persons studied the same 20 odorants, but each person received only one type of interpolated cue. The tip of the nose (TON) state was defined to exist when an initial familiarity rating was very high (upper 1/3 of the scale used), and the initial identification attempt had failed. The principle results were:

Relevant context evoked increased responding, and more correct identifications. The word cues were more potent than the colors in evoking correct responses.

The irrelevant cues actively interferred with naming. While evoking increased responding, like the relevant cues, the correct rate decreased relative to the no cue condition. Again, the words were very potent, while colors were marginally effective.

If subjects were in the TON state, then the relevant cues were four times more effective than when the TON state was absent. The TON state appears to be stochastic among persons. The probability that a given person will exhibit one or more TON events is .5.

NARROW-SPECTRUM CHEMORECEPTOR CELLS IN THE WALKING LEGS OF THE LOBSTER, HOMARUS AMERICANUS. Charles D. Derby. Boston University Marine Program, Marine Biological Lab, Woods Hole, MA 02543

Chemical input from leg chemoreceptors is necessary for eliciting effective localization and handling of food by lobsters. The specificity and threshold of single primary chemoreceptor cells in the legs of lobsters were examined by single-unit extracellular recording techniques. Several different types of narrow-spectrum specialist chemoreceptors were found, each type responding with maximal sensitivity to only one of the following compounds: L-glutamate, L-glutamine, L-arginine, taurine, betaine, or ammonium chloride. The most extensively studied type of receptor -- the L-glutamate sensitive cell group -- responded with less than 8% of the L-glutamate-response to 25 other compounds at equimolar concentrations, including chemically closely related compounds. The mean threshold of the population of L-glutamate sensitive cells was near 10^{-8} M; the lowest threshold recorded for any L-glutamate cell was 3.5×10^{-9} M. Ammonium chloride sensitive cells are also highly specific and have low thresholds; one NH_4Cl cell had a threshold of 3.5×10^{-14} M. The other groups of specialist cells -- L-arginine, L-glutamine, taurine, and betaine sensitive cells -- show equally strong specificity as well as thresholds of 3.5×10^{-8} to 3.5×10^{-9} M. There is also evidence for a protein specific cell; this cell responded to hemoglobin but not to its enzymatically digested components. However, there was one cell that did not fit the narrow-specificity response pattern: it responded to at least 7 rather different compounds tested at 3.5×10^{-4} M, 4 of 15 at 3.5×10^{-5} M, and still 3 of 15 at 3.5×10^{-6} M. These results indicate that the peripheral coding system in the legs of lobsters is based largely but perhaps not exclusively on specialist chemoreceptors.

ACTIVE ION TRANSPORT ACROSS THE CANINE LINGUAL EPITHELIUM IN VITRO. John A. DeSimone, G.L. Heck, & S.K. DeSimone. Physiology Dept., MCV/ VCU, P.O. Box 551, Richmond, VA 23298.

The dorsal epithelium of canine tongue actively transports one or more ions. The lingual epithelium, dissected from the underlying straited muscle, can be mounted in a Plexiglas chamber in the manner of a membrane separating two compartments. When oxygenated Krebs-Henseleit buffer is placed in each chamber and the temperature raised to 37°C, a potential difference develops across the tissue with the serosal surface becoming electropositive with respect to the mucosa. Because the electrochemical potential difference of all species is zero across the tissue, the potential necessarily arises from the transepithelial active transport of ions. The sign of the potential indicates that positive ions are being transported from mucosa to serosa, or negative ions from serosa to mucosa, or both. The potential is linked to metabolic cellular processes because: 1) it is temperature dependent being optimal at 37°C, and 2) it is dependent on tissue respiration - it diminishes by about 70% in an atmosphere of nitrogen. Restoration of O_2 restores the potential. Maximum potentials of 11.2 mV and 8.5 mV have been recorded in two preparations. The latter tissue was further studied by voltage clamping the potential and recording the short-circuit current. This was $24\mu A/cm^2$ in O_2 indicating an active ion flux of 250neq./cm^2 sec. I-V curves on this tissue showed that under N_2 the impedance declines by 45%. I-V curves were obtained with the mucosal solution replaced by various concentrations of NaCl. The open-circuit potential, under these conditions, is proportional to the logarithm of the mucosal NaCl concentration between 0.01 M and 0.25 M. The short curcuit current is a saturable function of salt concentration. It is possible that these ion currents have a role in chemotransduction.

PHYSICAL AND PSYCHOPHYSICAL PROPERTIES OF SURFACE ACTIVE TASTE MODIFIERS. J.A. DeSimone, G.L. Heck, S.K. DeSimone: Med. College of Virginia, Richmond, VA. 23298 and L.M. Bartoshuk and E. Bradley: Pierce Foundation, New Haven, CT. 06519.

3 synthetic surfactants have been studied psychophysically for their taste-modifying ability in man and compared with gymnemic acid (GA), a natural surfactant with taste-modifying properties directed mainly toward the sweet modality. In addition, we have studied in detail the surface chemistry of GA and compared it with one of the synthetics, sodium lauryl sulfate (SLS). The surface tension of GA solutions resembles that of SLS and other strong surfactants in that the surface tension decreases with increasing GA concentration until a critical micelle concentration (CMC) is reached. Above the CMC, the surface tension remains constant. For GA the CMC is 0.025 gm% (about 0.25 mM). The surface concentration of GA at the CMC is about 2×10^{-10} mole/cm^2 which means that a GA molecule occupies about 85Å^2 of surface area. GA penetrates phopholipid monolayers at concentrations as low as 0.0002 gm%. In this range the fall in surface tension is proportional to the GA concentration in solution, and the rate of decrease is diffusion-controlled. Data for SLS are comparable. In each case, the rate of penetration increases with increasing GA or SLS concentration. Although the effects of GA on taste are well known, its surface activity suggests that SLS and other surfactants may also be taste modifiers and that surface activity may be a necessary characteristic of a class of taste modifiers. Psychophysical studies in man on SLS, a negatively charged surfactant (like GA), show that at 0.05% SLS produces small but significant reductions in the sweetness of sucrose and the saltiness of NaCl. There is a larger reduction in the bitterness of quinine and a bitter component is added to the taste of citric acid. Additional studies on the cationic surfactant, cetylpyridinium chloride (CPC) indicate significant reductions in the sweetness of sucrose, the saltiness of NaCl and the bitterness of quinine at 0.005%. Finally the nonionic surfactant Tween-80 caused only a slight reduction in quinine bitterness at 1%. GA, SLS and CPC produce psychophysical response functions which are parallel displacements of the control functions in the direction of higher stimulus concentrations when plotted double logarithmically. Our results suggest that in addition to surface activity per se, the value of the CMC, the presence of charge and possibly other factors (such as steric hindrance, or van der Waals interactions) may play a role in determining differential effects on various modalities.

DISTANCE CHEMORECEPTION AND ORIENTATION TO FOOD ODORS IN THE AMERICAN LOBSTER. Dana Devine and Jelle Atema. Boston University Marine Program, Marine Biological Laboratory, Woods Hole, MA 02543

The roles of antennular and dactyl chemoreceptors in food odor orientation were examined by ablation experiments. Lobsters were tested individually in 800-liter aquaria, where they occupied a shelter in the middle of the back wall. Two continuously running water flows were directed from the side walls toward the center of the tank. The lobsters' behavior was observed and timed in response to a standard food odor injected into either flow.

Four treatments were performed: 1) unilaterally cutting the right lateral or 2) right medial branch of an antennule, 3) shaving the aesthetasc hairs from one lateral branch, and 4) coating the walking legs bilaterally in addition to unilateral ablation of a lateral branch. 1) Lobsters which underwent unilateral ablation of the lateral antennular flagellum lost their ability to initially detect the direction of the odor source, but they did not show preferential direction choice. 2) Unilateral medial ablation did not affect orientation ability. 3) Removal of the aesthetasc hairs from one lateral flagellum caused a loss of orientation ability similar to unilateral lateral ablation. 4) Lobsters with unilaterally ablated lateral flagella and blocked pereiopod chemoreceptors made a significant number of direction choices toward the side of the intact lateral flagellum.

In all treatments where a lateral flagellum was either shaved or removed, the paths followed by the lobsters in searching for the stimulus were significantly longer than those of intact animals. Thus, lobsters missing one lateral flagellum could no longer efficiently follow the changing stimulus concentrations within the odor cloud. Although intact lobsters appear to orient to odors principally by tropotaxis using aesthetasc receptor input, the pereiopod chemoreceptor input must also help to detect odor sources of relatively high concentration. Non-aesthetasc antennular receptors seem to have no role in orientation.

TIME COURSE AS A DISCRIMINATOR OF TASTE QUALITY IN PARABRACHIAL UNITS OF THE RABBIT. Patricia M. DiLorenzo and Jerome S. Schwartzbaum. University of Rochester, Department of Psychology, Rochester, NY 14627.

Taste-related activity was studied in 82 single units in animals maintained under halothane anesthesia. Two concentrations of each of the 4 basic types of tastants were delivered to the rostral half of the tongue by means of a gravity flow system and flow chamber.

The time course of response to the different tastants was examined by transforming the data to partial out differences in magnitude of response and by applying principal components analyses (PCA) to the transformed data. Stepwise discriminant analyses complemented the PCA. Analysis of responses to the high concentration of tastants over an 8.192 sec. period derived 4 principal components or "factors". On the basis of these factors, the time course of response to the high concentration of the tastants could be differentiated at almost 2X chance level. A similar analysis on units that responded to both concentrations of tastants revealed a similar set of components that could be used to discriminate the low concentrations of the tastants. Time course was also effective in discriminating tastants within the first 2.048 sec. of the response, but the discrimination was inferior to that utilizing 8.192 sec. of the response. It would appear from the PCA of the first 2.048 sec. that palatability of the tastants may represent a major feature in the early time course discrimination of the stimuli. In effect, the initial phase of response to tastants may code primarily the palatability of the stimuli while later phases of the response fine tune quality discriminations.

MICROCOMPUTER ARCHITECTURE FOR CAPTURING ACTION POTENTIAL WAVEFORMS WITHOUT AVERAGING. Dennis L. Director and Robert C. Gesteland, Northwestern University, Evanston, IL 60201

To study coding in the nervous system, the time between action potentials in the cell must be recorded. Extracellular microelectrode records, however, are often contaminated by activity of cells other than the one of interest. This unwanted activity can be identified and subsequently ignored if the waveform of each action potential is recorded with reasonable fidelity. Only digital methods accomplish this at reasonable cost. Attempts to use commonly available laboratory computers for the real time recording task are frustrated by inability to acquire data rapidly enough or by failure to store the data as rapidly as it is acquired. Even a fast machine dedicated to data acquisition may not suffice because transfering acquired data to disc can not occur while the bus is dedicated to acquisition. Specialized machines can be constructed utilizing dual-ported memory as the acquisition buffer. Not only is this memory expensive, it also must be rigidly tied to the acquisition device. The solution to this problem lies in an innovative architecture. An inexpensive laboratory computer with a dual bus acquires and stores real time data with style and elegance. We use the LSI-11 microcomputer. We adopt the Q bus for intersystem communication but split it into a processor bus and an acquisition bus. An arbiter connected to both decides when to allow information transfer between the two. The A/D converter runs at full speed, the processor runs independently of data acquisition, and the system disc drive can store the data from the acquisition buffer as quickly as if it were in the system main memory. All commercially available LSI-11 peripherals can be used without modification. The computer configured in this way remains as the general purpose machine in the laboratory and can be used for data analysis, document preparation and other standard computing tasks. This architecture improves throughput by about a decimal order of magnitude.

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GC/MS ANALYSIS OF MARMOSET SCENT MARKS. J. R. Donnelly, J. G. Kostelc, G. Epple, and A. B. Smith, III. Monell Chemical Senses Center, 3500 Market Street, Philadelphia, Pa. 19104.

A variety of behaviorally important messages such as gender, individuality, species, and social rank are conveyed *via* scent marks from specialized sternal and circumgenital glands, among such neotropical primates as *Saguinus fuscicollis, Callithrix jacchus,* and *Leontopithecus rosalia.* Previous research at the Monell Center dealt with the identification of relatively non-volatile chemicals (*e.g.* butyrate esters) from *S. fuscicollis.* Our present research uses gas chromatography/mass spectrometry to analyze the highly volatile fractions of the scent marks. Some components recently identified are: from *L. rosalia*--C_2-C_{10} acids, C_8-C_{18} hydrocarbons; from *C. jacchus*--C_{14}, C_{16}, C_{18} saturated and unsaturated acid methyl esters, C_{16}-C_{23} hydrocarbons, C_2-C_{10} acids, C_6-C_9 aldehydes. Numerous qualitative and quantitative differences have been observed among the three genera. For example, *S. fuscicollis* scent marks contain much lower concentrations of the highly volatile components than those of the other two genera, although all three contain some of the same classes of chemicals. While *L. rosalia* marks contain more hexanal, heptanal, and nonanal than do marks from the other animals, *C. jacchus* scent marks possess the greatest abundance of the short-chain acids. Further studies, utilizing direct headspace analysis and capillary gc/ms analysis, are underway.

DEVELOPMENT OF A SELF-ADMINISTERED MASS-SCREENING ODOR IDENTIFICATION TEST. Richard L. Doty. University of Pennsylvania Clinical Smell and Taste Research Center, 5th Floor Gates Bld., Hospital of the University of Pennsylvania, 3400 Spruce Street, Philadelphia, PA 19104

The most common dysfunction of the olfactory system in patients referred to our Center is total or partial anosmia. In the first phase of the development of a standardized smell test battery applicable to clinical settings, we have administered a 50 item forced-choice multiple alternative smell identification test encorporating microencapsulated crystals to a number of clinical and nonclinical populations. The simplicity and ease of administration, scoring and shipping of this test allows for large numbers of individuals to be examined for gross smell function with minimal supervision, effort and equipment. Data collected relating to the incidence of total and partial anosmia in these populations will be presented, along with analyses of the detection of malingering using this test procedure.

A "NEW" DIRECTION IN TASTE PSYCHOPHYSICS: ARISTOTLE AND HENNING. Robert P. Erickson. Duke University, Durham, N.C. 27706

Henning's contention that there is a continuum of tastes, rather than just four, appears insufficient to have countered the original formulation of this question by Aristotle - who placed it in the form of how many tastes there are; 3, 4 or 5 etc. Thus, present psychophysical research in taste finds itself limited to the evaluation of how much of each of a few separate tastes (the "primary four") there is in a given tastant, how much or how rapidly one or another of these four may be adapted, etc. And Aristotle's formulation also may be seen guiding the investigation of the chemistry and neural bases of the chemical senses.

Considering the importance of such formulations to our research and thinking, a valuable and somewhat "new" approach to taste psychophysics - at least as new as Henning - might be to test whether our taste world is like a 4-note piano, or something other than this.

We have recently examined the data put forth in support of the 4-primary position (Neurosci.Biobeh.Revs.,4,109-117,1980), and found that they are equivocal with respect to the distinction between that position and Henning's.

Three experiments were designed to determine whether humans perceive only 4 tastes or a continuum. In one (Physiol.Beh., 25, 527-533, 1980), it was shown that many taste mixtures (e.g. NaCl and HCl) are perceived as one taste; this would not be expected if each of the components ("salty" and "sour") was perceived. Other stimuli that are usually described by 2 or more terms - as "salty-sour" - were not clearly perceived as more than one taste. (Two notes on a piano are always perceived as more than one).

Two further experiments have shown that a) substances of a known taste may lose this identity in mixtures with other stimuli; and b)increasing the number of components in mixtures does not clearly increase the perceived complexity of the mixture. Both these findings are contrary to the results of mixing tones.

These experiments, each of which could have supported either position, suggest that taste is not simply composed of the "primary four". The continuous aspect of the spectrum of colors, and the rules of color mixture, may be a more accurate analogy than a 4-note piano.

The exception appearing in all these experiments is that sugars do tend to function as a group, partially distinct from the other stimuli used. This may lead to support for Aristotle in two general, diffuse classes of tastes, and Henning for the continuous internal structure for each class.

OLFACTORY INFORMATION PROCESSING IN TEMPORAL LOBECTOMIZED PATIENTS. Brenda Eskenazi, Karen Friend, William S. Cain, Eric Lipsitt, Michael Rabin, & Robert Novelly. John B. Pierce Foundation Laboratory, West Haven VA Hospital, and Yale University, New Haven, CT 06519.

Nineteen patients who had received temporal lobectomies for epileptic seizure control were evaluated on a battery of tests of olfactory functioning and olfactory information processing. Performance was compared to that of a group of 50 normal controls roughly matched to the patients for age, sex, and education. The battery included tests to evaluate absolute sensitivity, quality discrimination of relatively unfamiliar odorants, immediate and delayed recognition memory, matching of an odor to its visually presented or haptically presented source (stimulus objects), and odor identification using a list of names. We also employed a test to see how much information could be retrieved even if the person could not identify the odor (e.g., Is the substance edible or inedible?).

The majority of the patients possessed normal absolute sensitivity. Nevertheless, their performance fell below that of normal controls on quality discrimination and on most aspects of information processing. The only test on which the patients performed within normal limits was that of immediate recognition memory. On delayed recognition memory, the patients with right lobectomies performed better than those with left lobectomies but still worse than controls. No other differences between left and right lobectomies emerged.

As the size of the sample of temporal lobectomy patients, normal controls, and other brain-damaged controls continues to grow, we hope to be able to relate functional impairment to location or extent of the brain lesion.

TASTE PREFERENCE FOR HCL SOLUTION IN RATS WITH DIETARY INDUCED COPPER TOXICOSIS UNACCOMPANIED BY ZINC DEFICIENCY. Fay Ferrell, Jane E. Knight, and Carl L. Keen. Department of Nutrition, University of California, Davis, CA. 95616

Increased preference for HCl has been reported in dietary zinc deficiency and in rats made copper toxic by IP injection of $CuCl_2$. Mechanisms responsible for the preference changes are unknown. Cu and Zn can be antagonistic to each other with respect to intestinal absorbtion. In pilot studies from our laboratory, dietary induced Zn deficiency produced as a side effect elevated levels of liver Cu, but not plasma Cu. Zn deficient and control rats did not differ as groups in HCl preference, but liver Cu and plasma Cu were positivly correlated with high HCl preference in Zn deficient individuals. These preferences, not seen in controls, implicate a possible role for Cu in taste preference changes in Zn deficient rats.

The present research examined effects upon HCl preference of normal and toxic levels of Cu in diets with adequate Zn. Fifty-two weanling rats were assigned to one of four levels of dietary Cu, with concentrations of 10 ppm (control), 100 ppm, 500 ppm, and 1,000 ppm. Zn in each diet was 100 ppm. Rats were fed their respective diets throughout the study. After four weeks, six consecutive preference tests were performed using a 48-hour two-bottle free choice technique and employing 2.5×10^{-3} HCl vs. distilled water. Animals were then killed by exsanguination. Cu, Zn, and Fe concentrations in plasma and liver samples were determined by atomic absorption spectrophotometry. Liver manganese was determined. The concentration of liver Cu, Zn, and Mn was highest and liver Fe was lowest in the 1,000 ppm group. Variability in eating patterns increased with increased levels of dietary Cu, but the treatment groups did not differ in total fluid intake. No group differed from controls in HCl preference, and preference ratios decreased over the testing period in all four groups.

These results suggest that high levels of dietary Cu, in contrast to IP injections of Cu, do not consistently elevate HCl preference. Possibly, preferences would be affected by higher levels of dietary Cu. One explanation for the difference between the two methods is that IP injection may more readily precipitate Zn deficiency.

SURVIVAL AND TURNOVER OF THE OLFACTORY NEURONS AFTER REMOVAL OF THEIR TARGET. Ismail A. Fities and Giuseppina A. Monti Graziadei, Florida State University, Tallahassee, Florida 32306

In a continuous series of experiments dealing with the dynamics of the olfactory sensory neurons, we are exploring their survival and turnover rate after removal of their target. Neonatal (1-10 days old) and adult (2 months old) mice have been unilaterally bulbectomized and partially hemispherectomized to avoid reconnection of the olfactory sensory axons with the spared forebrain (Graziadei et al., 1978). Observations have been made on 30 animals after a postoperative survival time of 60 days. All the mice have been injected with ^{3}H-thymidine, and in order to find the most suitable experimental conditions, different time schedules for the injections have been used.

On the operated side, the morphological observations conducted at light microscopical level have shown that the regenerated olfactory neurons persist even when they do not reach a target, and that their axons form a neuroma in close proximity to the intracranial side of the lamina cribrosa. However, the olfactory neuroepithelium is thinner, due to a reduction in the neuronal population. The neurons have a large nucleus with a lighter chromatin pattern than the neurons of the unoperated side, suggesting the presence of a large population of young elements.

The autoradiographic observations demonstrate that, in animals sacrificed 1-2 hours after injection, the incorporation of ^{3}H-thymidine in the basal cell population is greater in the experimental than in the unoperated side, and that, after 24 hours, the nuclei contain a reduced number of silver grains. Labelled neurons disappear from the neuroepithelium at a faster rate than in the normal neuroepithelium. These preliminary observations seem to indicate that, while the survival of the olfactory neurons does not seem to be affected by the absence of a target, the maintenance of their normal turnover rate is highly altered by it.

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TYPES OF TASTE NEURONS IN THE HAMSTER CHORDA TYMPANI.
Marion E. Frank & David V. Smith. Univ. Conn. Health Ctr., Farmington, CT & Univ. Wyoming, Laramie, WY.

Hamster taste neurons have been placed into groups on the basis of their relative sensitivity to moderate intensities of sucrose, NaCl, HCl and quinine hydrochloride; test stimuli that represent 4 taste qualities. Neurons in each class have similar response profiles at each level of the nervous system that has been investigated but their breadth of tuning across the test stimuli differs at different levels. Yet, since response profiles within a class vary, it has been suggested that such categorization by "best" stimulus may be an arbitrary division of neurons that have a continuum of response profiles.

In order to see if support for the division of taste neurons into classes could be obtained, responses of 40 chorda tympani fibers of the hamster to 13 moderately intense stimuli (the 4 test chemicals plus fructose, Na-saccharin, $NaNO_3$, $MgSO_4$, KCl, NH_4Cl, citric acid, acetic acid and urea) were examined using multivariate statistical techniques. A factor analysis that compares across-stimulus correlations among fibers produced an orthogonal solution in which 3 factors accounted for 85% of the data variance. Each of 3 best-stimulus types of neurons (sucrose-, NaCl-, and HCl-best) comprised the major contribution to one of the 3 factors, demonstrating similarity in response profile across 13 stimuli within a class. The groups of neurons were located in clearly separate areas of the 3-factor space. A cluster analysis of the 40 response profiles, using a procedure to calculate cluster distances that compares each neuron's relative sensitivity to the 13 stimuli, provided evidence for 3 distinct clusters of fibers. The clusters coincided with the groupings portrayed by the factor solution, as well as those given by the best-stimulus approach.

Thus, statistical support for 3 types of neurons in the hamster chorda tympani has been obtained. For a particular neuron, class membership can be identfied and relative sensitivity to other stimuli predicted, if a response profile across 4 test stimuli representing different taste qualities is determined.

ODOR IDENTIFICATION vs.ODOR QUALITY MATCHING: A COMPARISON
María Rosa García-Medina (*),Laboratorio de Investigaciones Sensoriales,Facultad de Medicina,Universidad de Buenos Aires Suc.53,C.C.53. 1453-Buenos Aires,República Argentina.

Odor identification and odor quality matching were compared in a test using 10 commonly employed substances and 10 chemical reagents.Half of the odorants were familiar and the other half unfamiliar according with previous data.

Subjects were asked to rate familiarity of the stimuli in a seven points scale.After this they were given instructions into three separated groups.The first group was asked to name the odorants (odor identification).The second was also instructed to identify the substances but was helped by means of a list of names in wich those of the stimuli were included.The third group was instructed to match odors qualities of the odorants with those of a set of substances including the test odorants.

Results showed that:a)Normal subjects are able to identify approximately 50% of the substances;b)Helping the subjects with a list of names their performance improves almost up to 100% identification for the familiar substances but not for the unfamiliar ones;c)in spite of familiarity rate and whether the stimulus is a commonly encountered substance or a chemical reagent subjects are able to match the odor quality of 95 to 100% of the odorants.Odor quality matching then seems to be more adecuate than odor identification to assess olfaction since no previous knowledge of the substances is needed.

(*)Fellow of the Consejo Nacional de Investigaciones Científicas y Técnicas de la República Argentina.

MAGNITUDE MATCHING OF SWEET TASTE: INDIVIDUAL DIFFERENCES.
Janneane F. Gent & Linda M. Bartoshuk. John B. Pierce Foundation Laboratory, 290 Congress Ave., New Haven, CT 06519.

An application of the psychophysical technique of magnitude matching suggests that the perceived sweetness of sucrose and neohesperidine dihydrochalcone (DHC) is more intense for "tasters" of 6-n-Propylthiouracil (PROP) than for "nontasters."

In the first study described, 10 tasters and 10 nontasters, classified according to their thresholds for PROP, gave magnitude estimates for the intensity of sucrose, Na saccharin, DHC, QHCl, and NaCl. Stimuli for both studies were kept at 34°C and delivered to the front half of the tongue using the McBurney gravity flow system. Assuming that the intensity of NaCl is the same for tasters and nontasters, the data were normalized to the average rating for the strongest concentration of NaCl used. The results confirm a previously published difference between tasters and nontasters in the perceived sweetness of the lowest concentration of Na saccharin. There were also reliable differences between the two groups in the mid-range concentrations for the sweetness of DHC and sucrose, and for the bitterness of QHCl.

If, in fact, tasters perceive NaCl as saltier than do nontasters, then using NaCl as the normalization stimulus would tend to distort, actually minimize, any differences between the two groups. In the second study, 10 tasters and 10 nontasters made magnitude estimates of the taste intensity of sucrose, DHC, NaCl, and the loudness of 10 tones. Taking advantage of an assumed similarity between groups in the perception of auditory intensity, subjects were told to rate the loudness of the tones on the same intensity scale used to rate the taste stimuli. The data from the second study were then normalized with respect to the average loudness of the tones. For this particular group of subjects, the average sweetness of sucrose was two times greater for tasters than for nontasters. DHC was three times sweeter for tasters than for nontasters. The differences for the saltiness of NaCl were not statistically significant.

The method for matching the magnitudes of stimuli for two different sensory modalities seems to be a promising approach to the investigation of suspected differences in taste sensitivity between tasters and nontasters of PROP.

LOCALIZATION AND MORPHOLOGY OF THE SENSORY STRUCTURES MEDIATING PHEROMONE RECEPTION IN THE BLUE CRAB, CALLINECTES SAPIDUS.
Richard A. Gleeson. Monell Chemical Senses Center and C. V. Whitney Marine Laboratory, University of Florida.

Previous work has indicated that male blue crabs detect the pheromone of pubertal females via chemoreceptors located on the outer flagellum of their antennules (1st antennae). In the present study scanning electron microscopy was utilized to examine these flagella in order to identify structures potentially involved in pheromone detection. These studies revealed a tuft of approximately 650 aesthetascs (the presumed low-threshold chemoreceptors in crustaceans) which are arranged in rows on the ventral surface of each outer flagellum. The tufts are divided into mesial and lateral halves. Confined to the mesial half, proximal to the aesthetasc row of each segment, are groups of sensory hairs (0-4 per flagellar segment) with an external morphology unlike that of aesthetascs. No other sensory structures occur in the tuft region of the flagellum.

Experiments were performed in which the mesial half, lateral half, or entire aesthetasc tuft was bilaterally ablated from the antennules of test males. As revealed by behavioral tests, pheromone responses in "mesial half" and "lateral half" ablation groups were reduced 22% and 21%, respectively, relative to control ($P>.10$); whereas a highly significant ($P<.005$) response decrement (80% relative to control) occurred in the "entire tuft ablated" group.

These data suggest that pheromone reception in the male blue crab is effected via the aesthetascs.

ODOR-INDUCED ACTIVITY IN THE OLFACTORY BULBS OF NEONATAL RATS. Charles A. Greer, William B. Stewart and Gordon M. Shepherd. Sec. of Neuroanatomy, Neurosurgery and Gross Anatomy, Yale Univ. School of Medicine, New Haven, CT, 06510.

Studies employing electrophysiological, anatomical and behavioral techniques suggest that the olfactory system is functional in neonatal rodents. To further pursue this problem we have applied the Sokoloff 2-deoxyglucose (2DG) method to a systematic examination of the developmental course of activity patterns in the olfactory bulbs during controlled odor exposure. We report here that 2DG uptake in response to odor stimulation may be characterized by a series of stages during the course of ontogeny and moreover, that these changes may be correlated with the developing histological structure of the bulb.

Rat pups (0-21 days postnatal) were injected with 2DG immediately prior to controlled exposure to either pure air or a 10^{-1} flow dilution of amyl acetate. Autoradiographs from serial sections were then examined for patterns of 2DG uptake. Littermates were perfused with Bouin's solution and embedded in paraffin for histological examination.

Foci of increased 2DG uptake were found in even the youngest rats (12 hrs. postnatal) following exposure to amyl acetate. The distribution of foci conformed to the anterolateral and posteromedial spatial domains typical of the adult. The extent of uptake within the glomerular layer, however, was less than adult levels. A laminar analysis in the 0-day olfactory bulb revealed a band of high uptake corresponding to the glomerular, external plexiform and mitral body layers with lower activity found in the olfactory nerve and granule cell layers. This laminar pattern is similar to that found in the adult. In general, four stages of development were identified. Period 1 (0-3 days): Identifiable but indistinct foci of 2DG correlating with poorly differentiated olfactory glomeruli. Distribution of foci principally in the posteromedial region of the bulb. Period 2 (6 days): Appearance of sharp 2DG foci similar to those found in the adult and associated with markedly increased definition of glomeruli. Period 3 (9-12 days): Proliferation of 2DG foci in the anterolateral aspect of the bulb. Glomeruli continue to increase in number and definition. Period 4 (15-21 days): Stabilization of the 2DG uptake into the adult spatial pattern and final increases in the size of the bulb laminae.

These studies reveal a developmental sequence in the functional organization of the olfactory bulb which parallels changes in the histological organization of the bulb. The changes we have observed appear consistent with previous evidence for the development of function in the neonatal rat olfactory bulb.

TASTE JUDGEMENTS OF BRIEF STIMULI. Bruce P. Halpern and Steven T. Kelling. Department of Psychology and Division of Biological Sciences, Section of Neurobiology and Behavior, Uris Hall, Cornell University, Ithaca, NY 14853

Reaction times to, and judgements of, brief taste stimuli were obtained from trained observers. Aqueous liquids flowed at 10 ml sec^{-1} thru a 4 mm i.d. Teflon stimulus delivery tube. A 1.5 cm by 1.0 cm opening in the wall of the tube (viz. Bujas, 1935) was positioned near the tip of the tongue. A Teflon 4-way valve (Lester and Halpern, 1979) controlled by a microprocessor produced stimulus or control liquid pulses in the stimulus delivery tube. They were preceded by a 10 sec flow and followed by a 5 sec flow of control liquid. Rise time (time from 10% to 90% of final concentration) between control liquid and stimulus pulse was measured with pairs of flow-thru conductivity electrodes (Halpern and Meiselman, 1980) located just before, and after, the 1.18 cm^2 stimulus delivery opening. For 500 mM NaCl in distilled water, onset rise time (from distilled water) was 10 msec; offset (desorption) rise time (to distilled water), 85 msec, measured with the post-tongue electrodes. Pre-tongue times were 10 msec and 45 msec, respectively. Liquid pulse durations, and control or stimulus pulse trials, were randomized in all testing sessions, except that each testing session began with identified control, and then stimulus, pulse trials. Three practice sessions preceded regular sessions. Reaction times were measured to the nearest msec. Stimulus delivery tube conductivity electrodes received no voltage during data trials.

For 500 mM NaCl, median reaction times for 100 msec, 200 msec, 300 msec, and 1000 msec pulses were 356 ± 33, 386 ± 31, 435 ± 51 and 474 ± 51 msec (± standard error of median). Judged taste of the pulses varied with pulse duration. The 1000 msec 500 mM NaCl pulses were usually described as salty; the 100 msec pulses, sweet or sour. Reports of saltiness increased at the longer durations.

We conclude that 100 msec is not the limiting taste stimulus duration in humans if concentration is sufficient. The qualitative characteristics of brief pulses differ from those of longer pulses. This may indicate that the responses are actually to a "water taste", that the phasic neural responses presumably elicited by the brief pulses provide only part of the perceptual input made available by the presumptive phasic-tonic response to longer stimuli, or that a brief taste pulse gives sensory input similar to that of a lower concentration but longer duration stimulus.

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STRUCTURE OF AN UNUSUAL CONTACT CHEMOSENSORY SETA IN THE KELP CRAB, PUGETTIA PRODUCTA (RANDALL). K. A. Hamilton* and K. A. Linberg. Department of Biological Sciences and Marine Science Institute, University of California, Santa Barbara, CA 93106.

The terminal segment or dactyl of the walking legs of decapod crustaceans typically contains rows or tufts of rodlike chemosensory setae. Dactyls of the kelp crab, however, contain few rodlike setae. Instead, flat interlocking platelike setae cover most of the surface, not only of the dactyl, but of the entire body as well. Electrophysiological recordings from isolated dactyl preparations indicate that both rods and plates are chemosensory in P. producta. Because superficially plates do not resemble rod setae, the morphology of plates was examined using light and electron microscopy to determine how plates might resemble other types of arthropod chemosensory sensilla.

External and internal morphological characteristics of plate setae which suggest chemosensory function include: permeability of the rough apical cuticle to dye; presence of pore tubules at the tip; relatively large number (up to 12) of innervating neurons (each of which contains a ciliary region with 9 + 0 configuration of paired microtubules); lack of a well-developed scolopale characteristic of crustacean mechanoreceptors.

Other than the presence of pore tubules, the internal structure of plates resembles that of rodlike contact chemoreceptors. Although pore tubules generally characterize insect olfactory receptors, olfactory (aesthetasc) setae of crustaceans do not contain pores. Further, the distribution of plates in P. producta makes it unlikely that plates function as distance chemoreceptors. Pore canals, which pore tubules resemble, are thought to be secretory in crustaceans. Secretions arising from pore tubules may aid the contact chemosensory function of plate setae.

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ORIGIN OF THE PHASIC COMPONENT OF TASTE RESPONSES. Harry W. Harper. Rockefeller University, New York, NY 10021. Marion E. Frank. School of Dental Medicine, University of Connecticut Health Center, Farmington, CT 06032. Robert J. Contreras. Department of Psychology, Yale University, New Haven, CT 06520.

Single-fiber responses to different concentrations of a stimulus can yield clues to the origin of the phasic component of responses. If the origin is early in the steps which couple stimulation to action potential rate (e.g., if the phasic response is part of the receptor potential), then in all subsequent steps (e.g., action potential rates of single fibers) the phasic component should be in fixed ratio to the tonic component for each stimulus concentration. If the origin is late (e.g., in the coupling of receptor potential to action potential rate), the phasic-tonic ratio should be the same for all fibers responding at equal rates, regardless of stimulus concentration. Since different fibers vary widely in their responses to a given stimulus concentration, such an analysis is practical.

Data from 23 rat chorda tympani fibers with NaCl stimuli of .03, .1, .3, and 3 M concentrations were analyzed. The data for each concentration were rank ordered by response level, which gives an exponential form appropriate for least-squares analysis. This is required by the high variability encountered in single-fiber responses.

For all concentrations except 3 M, and for a tonic response range exceeding 6-to-1, the phasic-tonic ratio depends on response magnitude rather than stimulus magnitude, indicating a late origin for the phasic component. With 3 M NaCl the ratio decreases at all response levels, suggesting either some phasic contribution at an early step, or more likely a saturation effect.

The phasic increment in response (i.e., phasic response minus tonic response) is a very stable feature. While stimulus concentration varies by 100-to-1 and tonic response level varies by 10-to-1, the phasic increment varies little more than 2-to-1. In the context of taste quality coding, such behavior seems easier to reconcile with labeled-line than with across-fiber-pattern theories.

BEHAVIORAL AND NEUROPHYSIOLOGICAL STUDY OF MIRACULIN IN MACACA MULATTA Goran Hellekant, Department of Veterinary Science, 1655 Linden Drive, Madison, Wi. 53706.

In man miraculin from the berries of Synsepalum dulcificum changes the taste of sour substances to a sweet and sour taste. Administration of miraculin in a slice of banana to 18 rhesus monkeys, Macaca mulatta, changed their dislike to citric acid, ascorbic acid, aspartic acid, hydrochloric acid and sodium phosphate, pH 6.2, to a temporary liking.

Recordings of the overall activity in the chorda tympani proper nerves of the same monkeys demonstrated an enhanced response to these acids after application of 0.3 to 5 mg miraculin on their tongues. The enhancement diminished with time and was related to the amount of miraculin. A slight diminution of the nerve response to sweeteners was also recorded after miraculin.

Recordings of 29 single fibres were made before and after application of 1 or 5 mg miraculin on the tongue. These fibres were selected because they responded to acids, sweeteners or both. The nerve activity of 8 of these fibres was affected by miraculin.

The recordings obtained in these 8 fibres showed four characteristics: 1. The response to acids was enhanced by mirtaculin 2. The response to sweeteners was depressed by miraculin 3. The impulse acitivity immediately after miraculin during rinsing with water was enhanced, 4. NaCl gave no response before miraculin. After miraculin NaCl elicited a brief burst of impulses and then depressed the activity.

Recordings of the other 21 nerve fibres suggest that miraculin does not affect the response to acids of all fibers responding to acids, but that a fibre must possess some properties which make it susceptible to the effet of miraculin. One of these properties seemed to be a general sensitivity to sweet taste stimuli. Among sweet stimuli a sensitivity to monellin or thaumatin or both seemed most related to the effect of miraculin.

THE ANION'S EFFECT IN SALTY ELECTRIC TASTE. M. Scott Herness. Dept. Biology, Florida State University, Tallahassee, FLA 32304

There are several theories concerning the mechanism of electric taste. Evidence is presented in support of the theory that electric taste produces neural responses in a manner similiar to chemical stimulation by iontophoresis of ions to the taste cells. Is is believed that when anodal current is applied through a subthreshold solution, a separation of charges results with an accumulation of cations at the tongue surface, and that these positive charges stimulate the taste cells in a chemical fashion. The total current applied may be divided into two parts, the current carried by the cation and the current carried by the anion. The percentage of current carried by either ionic species (i.e. the transferance of that ion) is dependent upon the electric mobility of that ion. Thus, for a series of sodium salts, those salts with an anion of greater mobility will iontophorese less sodium to the tongue surface than a salt with an anion of lesser mobility since the anion would be carrying a greater percentage of the total current. Salts of the former category would be expected to produce smaller responses than salts of the latter. Such responses were qualitatively observed from whole nerve responses recorded electrophysiologically from rat chorda tympani. For a variety of sodium salts (0.001 M) applied to the tongue through a flow camber, different response magnitudes were abtained at equal current densities (10 - 50 $\mu amps/cm^2$). Those salts with a lesser sodium transferance produced smaller responses than salts with a larger sodium transferance. This observation is interpreted as evidence in support of the notion that it is the accumulation of cations at the tongue surface in response to anodal current which stimulates the taste cells in a manner similiar to chemical stimulation.

RESPONSE LATENCIES OF RAT CHORDA TYMPANI FIBERS DURING DEVELOPMENT. D. L. Hill, R. M. Bradley & C. M. Mistretta. Dept. Oral Biol., Sch. of Dent., Univ. of Michigan, Ann Arbor, MI 48109.

Response latencies are rarely reported in studies of the taste system. This may be due to the difficulty in determining exactly when a stimulus which is applied via a flow chamber contacts the tongue. Latencies can be measured easily, however, if solutions are applied from a syringe because an electrical artifact is produced when the stimulus first contacts the tongue.

As part of a study on the development of taste function, we have analyzed response latencies for 19 fibers in rats aged 14-20 days, 16 fibers in rats aged 24-35 days, and 20 fibers in adults during stimulation of the tongue with 0.1M and 0.5M NH_4Cl, NaCl, LiCl and KCl, and 0.1M citric acid. Response latency, defined as the time elapsing between the stimulus artifact and the first neural impulse, was measured from displays of neural activity on a storage oscilloscope. Fibers in rats aged 14-20 and 24-35 days had significantly longer response latencies to salts than fibers in adult rats. For example, the median response latencies to 0.1M NaCl in rats aged 14-20 days, 24-35 days and in adults were 89, 98 and 59 msec respectively. Citric acid response latencies also decreased during development, although the change was not statistically significant. Further, we found that within each age group, response latencies for citric acid were longer than those for salts and that latency decreased as salt concentration increased.

These results demonstrate that significant developmental changes occur in taste response latencies. Factors that may relate to the decreasing latencies are developmental changes in the access of stimulus to the receptor, receptor events, synaptic efficiency, and/or conduction velocity.

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GUSTATORY RESPONSES OF THE GERBIL TO METHYL α-D-ALLOPYRANOSIDE. William Jakinovich,Jr. CUNY, Lehman College, Department of Biological Sciences, Bronx, New York 10468

The purpose of this work was to determine the importance of the orientation of the hydroxyl group at position C-3 of methyl α-D-glucopyranoside to taste stimulation.

Such a determination is important because in insects maximal taste stimulation by methyl glycopyranosides requires an axial methoxy group at position C-1 and equatorial hydroxyl groups at positions C-2, C-3 and C-4. In mammals maximal taste stimulation or sweetness by methyl glycopyranosides requires an axial methoxy group at position C-1 and equatorial hydroxyl groups at positions C-2 and C-4. The requirement at C-3 is not known in mammals.

Therefore, an electrophysiological experiment was conducted in which the summated responses of the gerbil's chorda tympani nerve were compared when the tongue was stimulated by flowing sugar solutions, sucrose, methyl α-D-glucopyranoside (MAD-GLU) and methyl α-D-allopyranoside (MAD-ALLO). The results indicated that MAD-GLU was more stimulating than MAD-ALLO.

Therefore, the requirements for maximal taste stimulation by methyl glycopyranosides in the gerbil are the same as observed in some insect species - an axial methoxy group at position C-1 and equatorial hydroxyl groups at positions C-2, C-3 and C-4. Since many diverse animal species respond to sucrose and methyl glycosides in the same manner, we may be seeing parallel evolution of sugar taste specificity.

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CHEMICAL COMMUNICATION IN CROCODILIANS.
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The ability of yearling alligators (Alligator mississippiensis) to detect odorants was measured. While intraspecific chemical communication is an important aspect of the biology of many amphibians and reptiles, crocodilians have not been studied in spite of four prominent scent glands, two mandibular and two inside the cloaca, possessed by both sexes.

Seventeen yearling animals (50-60 cm in length) were presented with seven stimuli while gular pumping was recorded as a measure of the sniffing response to odors. Stimuli tested were: (1) two samples of cloacal gland secretions from adult males; (2) adult male mandibular secretions; (3) citronellol; (4) androstenol; (5) amyl acetate; (6) blank control. The animals were restrained in an olfactometer and odorants were presented in an airstream drawn across the animal's snout by an exhaust fan. Stimuli were presented for 20 sec following a 20 sec prestimulus period. The number of gular pumps greater in amplitude than those recorded during the prestimulus period were counted for the stimulus period. All samples were presented twice, each set in random sequence, and the responses averaged for each animal.

The results indicated that alligators responded most strongly to the cloacal gland secretions. Cloacal and mandibular gland secretions elicited responses which were significantly different from blank, androstenol, citronellol and amyl acetate ($p < .01$). Of the pure compounds, only the response to androstenol was significantly different from the blank. Responses to the two cloacal gland secretions were not different from each other but were different from the mandibular gland secretion ($p < .05$). The data demonstrate that yearling alligators respond differently to adult male glandular secretions compared with other odors. The role that these odors play in the biology of the alligator is not yet known.

PITUITARY CONTROL OF ODOR ELICITED LH AND SNIFFING RESPONSES IN MALE MICE. Robert E. Johnston. Department of Psychology, Cornell University, Ithaca, NY 14853.

The urine of female house mice affects males in a number of ways: it causes sniffing investigation, ultrasonic calling, and LH release from the pituitary. Another male's urine does not have the same effects. In the present experiments I investigated the hormonal control of the factors in female urine that influence sniffing and LH responses as one approach to learning more about the function of these responses.

In order to sample blood for LH assays male mice were prepared with indwelling cannulae five days prior to testing. For each test ten sequential 25 microliter samples were withdrawn at 5 min. intervals and subsequently assayed for LH concentration by micro RIA techniques. The five samples established baseline LH levels, a stimulus was then presented, and the last 5 samples measured the response. Urine from ovariectomized and intact females elicited LH responses but urine from hypophysectomized females and intact males did not, demonstrating the pituitary control of the factors responsible for alterations in LH levels. These factors may be the same as those responsible for eliciting ultrasonic calling, as Nyby has published similar results.

The behavior data suggest that both the pituitary and the ovary influence urine odors that elicit sniffing. Sniffing at the urine of ovariectomized females was significantly less than at the urine of intact or sham-op females, but significantly more than at urine from hypophysectomized females; responses to hypox urine and male urine were not different.

These experiments suggest that there are at least two cues in the urine of female mice that influence males, that these cues have different hormonal controls, and that the messages and functions of the two cues may be quite different.

TEMPERATURE EFFECTS ON THE ORIENTATION TO AN OLFACTORY CUE BY GOLDFISH. Keith A. Jones. Dept. of Biology, Texas A&M University, College Station, Tx. 77843

Both electrophysiological and behavioral studies involving chemoreception in fishes suggest that their orientation to environmental odors may be temperature dependent. Experiments were performed to quantify, first, the effect of thermal acclimation state on orientation and, second, the interaction between olfactory and thermal stimuli as orienting influences. Responses were measured electronically by photoelectric detection of the activity of goldfish in a tank offering a multiple choice situation of eight compartments. In the first test the percent time spent was measured in one compartment containing an extract of trout chow and in three control compartments. When contrasted against the controls, the percent time spent in the compartment containing the extract decreased steadily over the temperature interval of 26-34^{0}C.

In the second test the goldfish were given a simultaneous choice of four compartments containing one of the following: heated water only (H); the extract only (E); the heated water and extract combined (H&E); and neither stimulus present (control). The response to the four choice situation was measured when the heated water was maintained at 0.7, 1.5, 2.0, 2.5, and 3.5^{0}C above ambient temperature. As the temperature difference between the heated water and the ambient water increased H&E was increasingly preferred over E, which became indiscernible from the control. The response to H&E was maximal at a temperature difference of 2.0^{0}C and decreased slightly at differences greater than this. Part of the increased preference for H&E over E can be attributed to the attractiveness of the heated water itself (H). However, when the temperature gradient exceeded 1.5^{0}C there was a clear distinction between H and H&E, the response to the latter always being greater. The response to H&E could not be predicted from the sum of the individual responses to H and E, i.e. the effects of the stimuli are not additive. Thus, the results suggest that there is an interaction between the olfactory and thermal stimuli as orienting cues.

It is concluded that temperature, both as an acclimation factor and as a stimulus in its own right, affects the orientation by goldfish to an olfactory cue.

TASTE RESPONSES OF THE GLOSSOPHARYNGEAL NERVE IN THE CATFISH.
Jagmeet S. Kanwal and John Caprio. Dept. of Zoology and Physiology, Louisiana State University, Baton Rouge, LA 70803.

Electrophysiological investigation has revealed that the glossopharyngeal (IXth) nerve of the channel catfish, Ictalurus punctatus, contains taste fibers that respond to amino acids and the classical taste stimuli. The IXth nerve innervates taste buds on the ventral surface of the oral cavity and first gill arch. Electrophysiological reports of the IXth nerve taste responses in fish are few in number, and recent studies involving amino acid taste sensitivity in fishes have involved primarily facial (VIIth) nerve recordings (Caprio, 1975, 1978; Hidaka, et al., 1978; Goh and Tamura, 1980; Kiyohara, et al., in press). The objectives of the present study were to determine the response properties and chemospecificity of the IXth nerve and to compare these with similar data obtained from the facial taste system in the same species. Taste buds on the maxillary and nasal barbels, anterior palate and flank, innervated by facial nerves, are highly sensitive to amino acids, especially L-alanine and L-arginine, suggesting an analogous chemical response profile of facially innervated taste cells in the catfish.

In vivo glossopharyngeal recordings were obtained with a monopolar PT.-Ir. hook electrode from the cut peripheral end of the IXth nerve in the region of the branchial musculature adjacent to the cranium. The nerve responded phasically to mechanical stimulation of the oral epithelium; tactile stimuli consisted of pulsing water flow and gentle stroking of the epithelium. Additionally, spontaneous, tonically active units with response frequencies dependent upon the position of the first gill arch were observed in the majority of nerve bundles teased from the IXth nerve. Since this activity obscured the responses to chemical stimuli, taste recordings were obtained from nerve bundles showing little or no tonic activity. Chemical stimuli were injected into a constant flow of water bathing the oral epithelium. Integrated multiunit activity showed L-alanine and L-arginine to be the most stimulatory amino acids tested having thresholds below 10^{-6}M; thresholds for other amino acids tested were higher ($>10^{-5}$M). Individually identified taste units responded best to either L-alanine or L-arginine. The integrated phasic taste responses to amino acids rose exponentially with a corresponding logarithmic increase in stimulus concentration. Thus, the chemospecificity and response-concentration relationship of the facial and glossopharyngeal taste systems of the catfish to amino acids are strikingly similar.

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ACCUMULATION AND DISPERSAL OF TETRAHYMENA (CILIATA) IN RESPONSE TO AROMATIC AND INDOLE AMINES. Andrew Kehr and M. Levandowsky. Haskins Laboratories, Pace University, N.Y., NY 10038

Responses to aromatic and indole amines and amino acids were studied in the freshwater ciliate, Tetrahymena thermophila, using an assay based on rectangular microcapillaries (0.2x2.0x20.0 mm). Capillaries containing test and control solutions were submerged in a suspension of washed, starved cells for 1/2 hr; cell numbers in test and control capillaries were counted and compared by standard statistical methods.

Responses to different levels of tyrosine were trimodal: accumulation at 10^{-2} - 10^{-3}%; dispersal (repulsion) at 10^{-4} - 10^{-6}%; accumulation again at 10^{-7} - 10^{-10}%. This pattern was repeated in many experiments. Phenylalanine exhibited the two higher range responses, but not the attraction at very low levels. Dihydroxyphenylalanine (DOPA) gave accumulation from 10^{-6} - 10^{-2}%. Synthetic substituted tyrosine analogs gave various portions of the response pattern, and in some cases competitively inhibited parts of the tyrosine response.

A variety of indoleamines were studied: tryptophan, tryptophol, tryptamine, 5-OH tryptophan, serotonin, indoleacetic acid (IAA), and melatonin. These produced accumulations at moderately low concentrations (above 10^{-7} or 10^{-6}%), except for tryptamine, which gave dispersion (repulsion). Tryptophol produced a strong accumulation response down to 10^{-9}%.

ACTION OF GYMNEMIC ACIDS AND ZIZIPHINS ON CHEMORECEPTOR CELLS: DOSE-EFFECT AND TIME COURSE RELATIONSHIPS. Linda M. Kennedy and Bruce P. Halpern. Worcester Fndn. Exptl. Biol., Shrewsbury, MA 01545 and Dept. Psych. and Sect. Neurobiol. & Behav., Cornell Univ., Ithaca, NY 14853.

The gymnemic acids and ziziphins (from G. sylvestre and Z. jujuba) selectively suppress human sweetness perception, inhibit fly behavioral and taste receptor cell action potential responses to sucrose, and elicit action potentials from a fly chemoreceptor, the "fifth" cell. Chemical and psychophysical data support a role for modifier surface active properties, and we have proposed a biphasic membrane penetration process for the action of these modifiers on receptor cells. To characterize and evaluate the action, we measured the magnitude of stimulatory and inhibitory effects of a concentration series of purified gymnemic acids (KGE) and ziziphins (ZjE-A) on fly (P. regina) labellar chemoreceptor cells and followed the inhibitory effects for 10 min after modifier treatment.

Stimulation of the fifth cell and inhibition of the response to sucrose were significantly affected by modifier concentration ($p<0.03$). The lowest concentration of KGE or ZjE-A that produced a significant inhibition ($p<0.02$) was 0.025%, which is the critical micelle concentration (CMC) for KGE. Inhibition and stimulation increased with concentration to 0.05% for KGE or 0.075% for ZjE-A and then decreased. Although CMC may be necessary for inhibition, the shapes of the dose-effect curves suggest that some factor other than micelle concentration is responsible for the overall concentration effects.

There was no significant difference among slopes for increasing effects of KGE stimulation, KGE inhibition, ZjE-A stimulation and ZjE-A inhibition ($p>0.3$). Regression of medians for the various increasing effects on each other yielded slopes of 0.64-1.35 ($r=0.8$-0.95). Thus mechanisms for stimulation and inhibition by KGE and ZjE-A may be similar.

During the 10 min after modifier treatment, firing rates to sucrose were initially depressed and then increased and oscillated near control values. As predicted by the biphasic membrane penetration model, the increase after the most potent KGE concentration was significantly faster than that after the most potent ZjE-A concentration ($p\leq 0.005$).

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SPECIFICITIES OF OLFACTORY RECEPTORS. Steven J. Kleene and Robert C. Gesteland. Northwestern University, Evanston, IL 60201

The number of olfactory receptor types and the specificity of each in the leopard frog (Rana pipiens) are being investigated by means of a previously published procedure (M.L. Getchell and R.C. Gesteland, Proc. Natl. Acad. Sci. USA 69, 1494-1498 (1972)). The head of the frog, after removal of both dorsal olfactory epithelia, is maintained in a water-saturated atmosphere of 95% O_2/5% CO_2. The electro-olfactogram (EOG), a measure of the summated olfactory receptor potentials in response to a given odorous stimulus, is measured from the ventral epithelium with a saline-filled micropipette. Exposure of the epithelium to a solution of N-ethylmaleimide (NEM) in Ringer's reduces the amplitude of the EOG to less than 25% of its previous value. If a particular odorant is present in solution during the NEM treatment, however, the EOG in response to that odorant (or to others presumably handled by the same receptors) gradually returns toward its pre-treatment amplitude. The EOG amplitudes in response to odorants handled by other receptor types do not recover. In each experiment, the left epithelium of the frog is treated with both NEM and the protecting odorant; the right side is treated only with the protecting odorant as a control. Such experiments have been performed using a number of odorants as protecting stimuli during the NEM treatment. Odorants were selected which encompass a wide variety of chemical structures and perceived odor qualities. We are also investigating the effects of NEM treatment on single unit activity and motility of olfactory cilia.

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ODORANT RESPONSES OF Na^+-K^+ ATPASE ACTIVITY BY PREPARATIONS FROM PAIRED TURBINALS OF RAT OLFACTORY TISSUE. R. B. Koch and Hernan Rossi, Dept. of Biochem., Miss. State Univ., Miss. State, MS 39762.

Olfactory tissue was obtained from 50 adult male Sprague Dawley rats. The olfactory capsule containing the turbinate tissue was removed and then individual turbinals removed from the left and right side. Eight groups of turbinals (four from each side) were separated and composite samples of each turbinal prepared. Homogenates of each composite sample were made using 0.32 M sucrose solution and nerve ending particle (NEP) fractions were prepared by differential centrifugation.

Na^+-K^+ ATPase activities and their responses in vitro to seven odorous chemicals were measured for each NEP fraction. Each odorous chemical, including the optical isomers d- and l-carvone, generated different patterns of responses of Na^+-K^+ ATPase activity in the eight fractions. Analysis of the results from paired left - right turbinals showed no indication of bilateral symmetry of the odorant responses.

CANINE BEHAVIORAL RESPONSES TO URINE. Deena H. Krestel. Purdue University, Biochemistry, Dept., West Lafayette, Indiana 47907

Urine and its odors are known to have communicative significance for many animals for various reasons; courtship, mating, territoriality, etc. This investigator examined the dog's behavioral responses in an open-field set up to samples of estrous and anestrous female dog urine, male dog urine and human urine. An analytical technique used for fractionating some of the urine samples was High Pressure Liquid Chromatography. It proved to be a good approach for separation of chemical compounds in the urine which are of interest to the dog. It shows great potential for isolation of these (pheromonal) compounds of interest. Behavioral responses to other odors popular in olfactory literature were also observed. Behavior was filmed and recorded with a computerized event recording device. Telemetry was employed to collect heart rate data as a physiological response to the odors.

HIGH RESOLUTION 2-DEOXYGLUCOSE AUTORADIOGRAPHY IN THE OLFACTORY BULB. Doron Lancet, Charles A. Greer and Gordon M. Shepherd. Sec. Neuroanatomy, Yale Univ. Sch. Med., New Haven, CT. 06510

The 14C-2DG method has proven very effective in assessing the functional organization in the olfactory system (Stewart et. al. (1979) J.C.N., 185: 715-734). However, an inherent limitation when using the conventional Sokoloff technique allows resolution only down to approximately 20um, or at the laminar level. This problem may be circumvented by utilizing a modified high resolution technique which affords discrimination down to 2um, or at the cellular level. We have been adapting the procedure of Sejnowski et. al. (1980) (Nature, 287: 449-451) for high resolution light microscopy autoradiography to the olfactory systems of the rat and turtle. Essentially, the procedure entails freeze substiution of the tissue in acetone at -70°C followed by plastic embedding, sectioning at 1-4um, coating with photographic emulsion and exposing for 2-12 weeks.

Following controlled odor stimulation experiments with rats the high resolution procedure revealed a laminar distribution of 14C-2DG uptake consistent with that previously reported using the conventional Sokoloff procedure. In addition, we observed differential uptake at the level of the single glomerulus. Adjacent glomeruli often had different levels of uptake and within a single glomerulus higher activity was observed in the internal neuropil than in the surrounding periglomerular border.

We also utilized the high resolution 3H-2DG method with the turtle in vitro preparation (Greer et. al. (1981) Brain Rsch., In Press). Following electrical stimulation of the olfactory nerve, differential laminar uptake patterns were more distinct than previously observed with 14C-2DG and conventional processing. In regions distant from activated glomeruli, there was a particularly sharp boundary between the external plexiform layer (high grain density) and the glomerular and nerve layer (lower density). In several cases the grain density was discriminately higher over neuropil than immediately adjacent cell bodies, demonstrating the high level of resolution attainable with this technique.

These studies are increasing our knowledge of the morphological substrates of 2DG uptake in the olfactory bulb. Similar applications of this technique to olfactory epithelium and bulb in the salamander, also reported in this volume, corroborate these findings. Continuing studies are aimed at further improvement of resolution and extending the investigations to the ultrastructural level.

ODOR ELICITED PATTERNS OF 2-DEOXYGLUCOSE UPTAKE IN THE SALAMANDER OLFACTORY PATHWAY USING HIGH RESOLUTION AUTORADIOGRAPHY. Doron Lancet, Charles A. Greer, Gordon M. Shepherd, John S. Kauer Sections of Neuroanatomy and Neurosurgery, Yale University School of Medicine, New Haven, CT 06510

We have examined uptake patterns in the olfactory epithelium and bulb of the intact tiger salamander (Ambystoma Tigrinum) in response to stimulation with amyl acetate using the conventional 2-deoxyglucose (2DG) technique and a modification designed for obtaining resolution approaching the cellular level (cf. Lancet et al., this volume). Animals were exposed for 1-2h to odor at controlled flow rate and concentration after injection of 14C-2DG into the dorsal lymph sac. Using high resolution autoradiography, increased uptake in the nasal sac was observed in the Bowman's glands and in some superficial regions of the epithelium extending from the supporting cell nuclei level to the mucosal surface. The epithelial uptake was distributed heterogeneously across the mucosal sheet; differences were observed between the dorsal and ventral epithelia as well as along the anterior-posterior and medial-lateral axes.

In the olfactory bulb the olfactory nerve and glomerular layers showed increased uptake using both the conventional and high resolution methods. Different regions of these layers displayed varying levels of 2DG uptake. Employing the high resolution technique there appeared to be defined regions of activity relating to specific intra- and extraglomerular compartments. In addition, discrete foci approximating the size of cellular structures were seen in the external plexiform, mitral body and granule cell layers. Some of these grain clusters appeared to be superimposed on individual cells.

The uptake patterns in the epithelium are in accord with electrophysiological analyses suggesting heterogeneity in the distribution of receptor types in the salamander olfactory mucosa (Kauer, J.S., ISOT VI, LeMagnen and McLeod eds., 125-133 (1977), Kubie, J., Mackay-Sim, A. and Moulton, D.G., ISOT VII, van der Starre ed., 163-166 (1980)). In the bulb the differential uptake in the glomerular layer is consistent with the spatial distribution of odor elicited 2DG uptake in other species. In conclusion, these results demonstrate that the use of high resolution 2DG autoradiography provides the potential for the simultaneous examination of the metabolic changes in cellular components mediating odor processing at all levels of the salamander olfactory system.

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ODORANT SPECIFIC PATTERNS OF DIFFERENTIAL SENSITIVITY INHERENT IN THE SALAMANDER OLFACTORY EPITHELIUM. Alan Mackay-Sim and David G. Moulton. Department of Physiology, University of Pennsylvania and V.A. Medical Center, Philadelphia, PA 19104.

The anterior and posterior regions of the salamander olfactory epithelium show different responses to some odorants, even when chromatographic-like adsorption of odorants by the mucus is eliminated (Kubie and Moulton, Soc. Neurosci. Abstr., Vol. 5, p 129, 1979). We have undertaken a more detailed mapping to elucidate the resolving power of inherent spatial patterning. Electro-olfactograms (EOGs) were recorded at different points on the epithelium after punctate odorant stimulation at the electrode tip. We directly compared relative sensitivity to different odorants by measuring EOGs at 30 points across the ventral olfactory mucosa. At each of these points, amplitudes of at least 3 EOGs were measured in response to 1 sec pulses of each of two odorants. Maps for each odorant pair were made of epithelia from at least 8 animals. These maps reveal differential sensitivity across the epithelium that is more complicated than simple anterior/posterior differences. For example, the maps for pinene and limonene, both generally posterior stimulators, also reveal smaller areas ($\frac{1}{2}$-1 mm^2) with extremely large responses. At present though, no differences in the distribution of sensitivity to pinene and limonene can be detected. In contrast, the distributions of sensitivity to eugenol and isoeugenol can be clearly distinguished. In addition to distinct separation of the points of maximal sensitivity to each of these odorants (often 2 mm apart), the epithelium can be divided into a postero-lateral segment ($\frac{1}{4}$-1/3 of the ventral olfactory epithelium) which is absolutely more responsive to eugenol, and the rest, which is absolutely more responsive to isoeugenol. Response maps for other odorants (propanol, butanol, decanol, heptaldehyde) reveal areas on each epithelium that are highly sensitive to these compounds. The locations of these areas are more variable, but distinct from the area most responsive to pinene and limonene. The map of responses to amyl acetate reveals a distinct ridge of high sensitivity commonly stretching anteriorly for about 2 mm from the posteriorly located pinene or limonene sensitive area. We conclude that there exist regions of enhanced senstitivity specific for different odorants. The variations in the shapes and positions of these regions indicate that the olfactory epithelium may have a well developed capacity to discriminate among odorants on a topographic basis.

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WITHOUT INTERNEURONS, MITRAL CELLS ECHO RECEPTOR CELLS
Robert G. Mair and Robert C. Gesteland. Northwestern University, Evanston, IL 60201.

The response properties of olfactory bulb neurons depend on 1) the pattern of activity evoked among receptor axons, 2) the integrative mechanisms by which these inputs are summated, and 3) the influences of olfactory bulb interneurons. The two day old rat pup has a simplified olfactory bulb containing few interneurons, all of which appear to be immature when stained and viewed with Golgi techniques. We recorded single unit activity from the olfactory bulbs of one to six day old rat pups to learn about the integration of receptor activity by mitral cells. In some preparations neurons were recorded while the animals' noses were closed, restricting stimulus events to the inspiratory phase of the respiratory cycle. Respirations were monitored. In other preparations, neurons were recorded after the animals' noses were opened. Odorants were delivered directly to the epithelium and EOG activity recorded. Neurons driven with the closed nose preparations (N=28) responded in one of two ways. Some were excited by weak to moderate concentrations of effective stimuli (0.2 to 2% saturation). These cells were always driven in synchrony with inspiration Others were inhibited by relatively strong stimuli (2 to 10% saturation). Neurons driven with the open nose preparation always exhibited the same pattern of activity. This consisted of increased excitation during weaker stimulus events, excitation followed by decreased activity for moderate stimuli, and inhibition for stronger stimuli. The concentrations evoking these responses differed by as much as two log units for different neurons. Neonatal olfactory bulb response properties resemble excitatory responses evoked from rat olfactory receptor neurons in all respects except that bulb neurons do not exhibit decrementing action potentials prior to periods of diminished activity. These response properties differ radically from those observed in adult rat olfactory bulbs.

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THE QUANTIFICATION OF RELATIONSHIPS AMONG OLFACTORY STIMULUS-RESPONSE PARAMETERS.
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Olfactory acuity is modeled in terms of stimulus-response relationships that incorporate such factors as the response characteristics of single olfactory receptor cells, the integration of these responses by the central nervous system, and the morphological as well as the fluid-dynamical characteristics of the olfactory systems in different animals so long as the systems satisfy certain basic criteria. The use of the model is demonstrated by applications to both vertebrate and invertebrate olfaction.

A CENTRAL NERVOUS SYSTEM GLUCOSTAT INVOLVED IN INSULIN HYPOGLYCEMIC CONVULSIONS?
Mary Ann Marrazzi, John F. Holliday, Joan L. Luby & Kathy W. Fish, Dept. Pharmacol. Wayne State Univ. Sch. Med., Detroit, Mich. 48201.

Systemic administration of gold thioglucose (GTG) causes histological damage focused relatively selectively but not exclusively in the ventromedial-arcuate hypothalamus (VMH) and is well known to produce hyperphagia and consequent obesity. In addition, GTG produces a biphasic change in sensitivity to insulin hypoglycemic convulsions-a decrease at early times (16 & 24 hrs) and an increase at later times (1-2 weeks) after GTG treatment. Both changes are prior to weight gain. For both changes, blood glucose shows that the hypoglycemic response to insulin is the same. The difference is in the convulsive response to hypoglycemia, rather than in the degree of hypoglycemia in response to insulin. CBA/J ♀ mice were treated with GTG (0.8mg/g IP), gold thiomalate (GTM)(0.8mg/g IP) or n-saline, all in 0.01 ml/g. GTM does not cause the histological damage or hyperphagia and is used as a control for nonspecific effects of gold thio-compounds. GTG did not alter sensitivity to Metrazol or fluoroacetate induced convulsions, i.e. did not alter the generalized convulsive threshold or even all metabolic convulsions. At 3 & 9 hrs. after GTG, neither a change in sensitivity to insulin hypoglycemic convulsions nor histological damage in the VMH visible with cresyl violet were seen. The functional changes did not seem to occur prior to the cytological damage. It has been proposed that localization of GTG toxicity, despite systemic administration, depends on binding of the glucose moiety of GTG to "glucoreceptors" and hence concentration of the toxic gold thio portion. This hypothesis suggests that a functional change due to receptor block might occur during the latency in establishing the cytological damage. Our evidence does not support this. In any case, our results suggest that GTG lesions a functionally described "GTG lesioned glucostat" - a glucose sensing and regulatory center involved in adjusting brain function in insulin hypoglycemia. A relatively discrete control center, not just a generalized power failure, may be responsible for the neurological deficits. In accord with this, others have shown that brain energy reserves are not markedly depleted despite insulin hypoglycemic convulsion and coma. The biphasic nature of the change in sensitivity suggests two opposite regulatory components. NIH # 5R01 AM 21476.

CENTRAL GUSTATORY PROJECTIONS IN THE CARP.
Takayuki Marui. Dept. of Oral Physiol., Kagoshima University, Dental School, Kagoshima, and Dept. of Oral Physiol., Gifu College of Dentistry, Gifu, Japan.

Neural responses to chemical stimulation of the external gustatory system were studied electrophysiologically in the immobilized carp. The response characteristics of the primary, secondary and tertiary neurons to taste stimuli delivered to the outer skin of the face were analyzed. A total of 77 primary neurons responsive to chemicals were recorded with a Ag-AgCl wire electrode. A total of 258 secondary and 36 tertiary gustatory neurons were recorded with glass microelectrodes filled with 3M KCl or 2M NaCl solution. All neurons in the three levels were classified into 5 types according to their response patterns to the 4 basic taste solutions. Although the majority of taste units identified were excited by one or two of the classical taste stimuli, inhibition was observed. The percentage of neurons that were inhibited by taste stimuli increased with the corresponding increase in the anatomical recording level. The responsiveness to sodium chloride was the best among the 4 basic chemicals at every neuron level. All projections of the primary neurons in the facial lobe were ipsilateral. Most neurons in the lobe responded only to mechanical stimulation. Taste neurons were located in the tactile sensitive area and 90% of them were responsive to tactile stimulation. These taste and tactile neurons showed a topographical relation to each body region in the lobe. The gustatory neurons of the superior secondary gustatory nucleus (nGS) were also centered in the tactile sensitive area and 94.4% of them gave tactile responses. These taste and tactile neurons in the nGS showed a similar but somewhat diffuse topographic relation as found in the facial lobe. These results are consistent with some anatomical reports. The sizes of tactile and taste receptive fields increased with the ascending neuron level. The receptive fields of the tactile units in the nGS ranged from 100 mm^2 to the entire facial skin surface and some fields extended into the trunk. Evidence for ipsilateral, contralateral and bilateral projections of secondary gustatory fiber to the nGS was obtained. Eight out of 36 taste neurons responded to stimulation of the facial skin surface contralateral to the recording site, 18 to ipsilateral stimulation. The remaining 10 neurons responded to bilateral stimulation and showed complicated responses. The complicated responses of the bilateral projection system are suggestive of complex central fiber connections of the gustatory systems.

OLFACTORY RESPONSES TO BLOOD-BORNE ODORANTS. Joel Maruniak, Wayne L. Silver and David G. Moulton. Department of Physiology, University of Pennsylvania and VA Medical Center, Philadelphia, PA 19104.

When human subjects receive odorant injections intravascularly they report an odorous sensation. How these odorants reach the receptors (either exhaled from the lungs or more directly) has long been a matter of controversy. To clarify this question and investigate the phenomenon further, we recorded pigeon olfactory nerve twig responses to odorants delivered intravascularly and in the vapor phase. Vapor phase odorants were generated in an air dilution olfactometer and delivered by a Teflon tube inserted into the bird's external nares. Odorous solutions were injected into the arterial blood supply through cannulas in either the internal or external carotids. To stimulate intravascularly, we injected 0.03 ml of odorant in saline solution or a saline control over a 3 second period.

Intravascular injection of an odorant, but not the saline control elicited olfactory nerve twig responses which were similar to those obtained from vapor phase stimulation. The response to intravascular stimulation did not arise from odorants diffusing from the lungs into exhaled air since tracheotomized birds exhibited responses similar in magnitude to those of intact birds. The intravascular response magnitude was concentration dependent, increasing with increasing odorant concentration. Thresholds for odorants delivered intravascularly and in the vapor phase were obtained and compared. In general the magnitudes of the intravascular responses to odorants approached those of the vapor phase responses. This indicates the need for further research to determine whether physiological fluctuations of intravascular odorants following food intake or in disease states can alter olfactory sensitivity.

(Supported by NIH grants HD 05547 and NS 10617).

SELECTIVE, REVERSIBLE ANOSMIA IN TIGER SALAMANDERS (AMBYSTOMA TIGRINUM) INDUCED BY CHEMICAL TREATMENT OF THE OLFACTORY EPITHELIUM. J. Russell Mason, Monell Chemical Senses Center, Philadelphia, PA 19104 and Thomas Hellman Morton, Department of Chemistry, Brandeis University, Waltham, MA 02254.

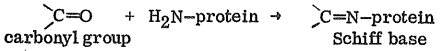
Tiger salamanders (Ambystoma tigrinum) can be conditioned to respond to a variety of reagent grade odorants and can discriminate and generalize among them.[1-3] These phenomena permit the behavioral assessment of selective alterations of olfactory acuity reported here. Tiger salamanders were trained to respond to two different odorants in an olfactometer. Each animal was conditioned to show avoidance to cyclohexanone (3.1×10^{-6} M in air) and dimethyl disulfide (8.4×10^{-6} M in air) but not to n-butanol (1.6×10^{-6} M in air). Then, nasal lavages were given with various concentrations of cyclohexanone, dimethyl disulfide, n-butanol and ethyl acetoacetate (0.05 M, 0.01 M, and 0.001 M in normal saline solution), and the animals tested for maintenance of conditioned responding to cyclohexanone and dimethyl disulfide. The results clearly demonstrate that 0.05 M or 0.01 M lavages with cyclohexanone or ethyl acetoacetate produce selective, reversible anosmias for cyclohexanone (p's < 0.01), while lavage with dimethyl disulfide produces a selective reversible anosmia for that odorant ($p < 0.05$).

These findings are the first to show chemical induction of a durable and concentration-dependent selective anosmia in laboratory animals. They are consistent with the notion that covalent bond formation between odorant and receptor plays a role in olfactory detection of at least one class of odorants.

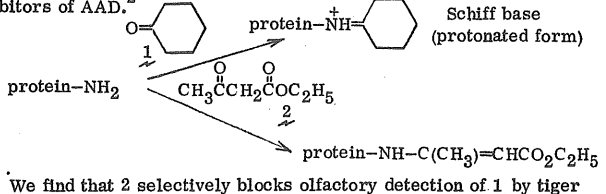
1. J. R. Mason, D. A. Stevens, and M. D. Rabin, Chem. Senses 5, 99-105, (1980).
2. J. R. Mason and D. A. Stevens, Physiol. Behav., in press.
3. J. R. Mason, PhD Dissertation, Clark University, 1980.

SELECTIVE, REVERSIBLE ANOSMIA IN TIGER SALAMANDERS (AMBYSTOMA TIGRINUM) INDUCED BY CHEMICAL TREATMENT OF THE OLFACTORY EPITHELIUM. J. Russell Mason, Monell Chemical Senses Center, Philadelphia, PA 19104, and Thomas Hellman Morton, Department of Chemistry, Brandeis University, Waltham MA 02254

It is not known whether covalent bonds are ever formed between odorant molecules and olfactory receptors in the course of transduction. If the belief that it is possible to recognize ketones or aldehydes by odor alone has any foundation, then it suggests a characteristic mode of binding carbonyl groups at the receptor. One well precedented binding mode for ketones and aldehydes in biological systems is through formation of a Schiff base with a protein,



We have explored the hypothesis that olfactory detection of ketones can be temporarily blocked by competitive inhibitors of Schiff base formation. For model studies, we have examined the Schiff base-forming enzyme acetoacetate decarboxylase (AAD). The pure polypeptide is known to bind cyclohexanone, 1, reversibly.[1] We find that ethyl acetoacetate, 2, competitively inhibits AAD. The proposed mechanism for inhibition by 2 shown below is based on precedents for other known inhibitors of AAD.[2]



We find that 2 selectively blocks olfactory detection of 1 by tiger salamanders. For animals conditioned to avoid both 1 and dimethyl disulfide (DMDS), lavage of both olfactory sacs with a 0.05 M solution of 1 impairs response to 1 but does not affect response to DMDS. This effect persists for several days, and lavage with 0.05 M 2 has the same effect. Lavage with 0.05 M n-butanol (as a control) has no effect.

1. S.A. Benner, J.D. Rozzell, & T.H. Morton, Journal of the American Chemical Society, in press.
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PATTERNED ACTIVITY IN A COMPUTER SIMULATION OF THE ANATOMICAL CONNECTIONS IN THE OLFACTORY BULB. M.Meredith and D.M. Marques, Worcester Foundation for Exptl. Biology, Shrewsbury, MA. 01545

2-deoxyglucose (2DG) experiments (Stewart et al, 1979, J. Comp. Neurol. 185; 715) suggest that different odors activate different small areas of the olfactory bulb and that the activated area expands as the intensity of the odor is increased. This suggests that the sensitivity for a particular odor quality falls off with the distance away from its focus of activity on the bulbar surface. When an increasing intensity of afferent input is simulated in a computer representation of the bulbar neural network, wavefronts of excitation and inhibition radiate out from the center of the activated area. Different temporal patterns of activity thus appear in output elements at different distances from the center. The range of temporal patterns produced in different parts of the output matrix is similar to that seen in the olfactory bulb (Meredith & Moulton 1978, J. Gen. Physiol. 71; 615).

The simulated network consists of a 30x30 matrix of output "cells", each representing the group of cells recieving input through a single glomerulus. The output calculated for each of these "cells" is determined by the interaction between the excitatory input and lateral inhibition from surrounding points via two mechanisms which simulate granule and periglomerular (PG) cell inhibition. In the program, the inhibitory influences radiate out from each matrix location to the extent estimated in Pinching's anatomical analysis of the spread of cell processes in the rat olfactory bulb (Olfaction & Taste IV; 40, 1972).

Output cell to output cell inhibition via the granule cell pathway depends on the level of output of the inhibiting cell, reduced according to the distance between the cells (cable loss) and the fractional area of overlap of their secondary dendritic fields. The PG inhibition of output cells includes dendrodendritic inhibition from PG cells belonging to the same glomerulus and axodendritic inhibition from PG cells belonging to surrouding glomeruli. It depends on the level of excitation of PG cells and these recieve their input directly (from olfactory axons) as well as indirectly from the output cells of their own glomerulus (via reciprocal synapses).

The effectiveness of these inhibitory pathways can be independantly varied in the computer program as can the intensity and distribution of excitatory input, the proportion of direct vs indirect PG excitation and the length constants of output cell processes. Temporal patterning of the output activity is dependant primarily on the spatial distribution of excitatory input but is relatively unaffected by a wide range of values for other variables. (Supported by NINCDS grant NS 14453)

TASTE BUDS IN THE CIRCUMVALLATE PAPILLA OF YOUNG AND OLD RATS. C. M. Mistretta. Dept. Oral Biol.,S. Dent.& Research Area, S. Nurs., Univ. Michigan, Ann Arbor, MI 48109. B. J. Baum. Lab. Molecular Aging, Natl. Inst. on Aging, Balt. City Hosp., Baltimore, MD 21224.

To learn whether there is an age-related loss of taste receptors, we compared the number of taste buds in the circumvallate papilla in two groups of Wistar-derived rats: ten aged 6 months and eleven aged 24 months. (Estimated human equivalent ages are 25 and 70 years, respectively.) The circumvallate papilla was dissected from formalin-fixed tongues, embedded in paraffin, and cut in serial transverse sections that were stained with hematoxylin and eosin. To determine number of taste buds per papilla, we counted every appearance of all taste buds; then the total of all appearances was divided by the average number of sections occupied by one taste bud.

There is no significant difference in the number of circumvallate taste buds in these two age groups. For rats aged 6 months the mean number of buds per papilla is 458 ± 61 (S.D.), compared to a mean of 468 ± 88 (S.D.) for 24 month rats ($t = 0.30$, $df = 19$, $p > 0.10$). These results contrast with those in an earlier report on age-related changes in mouse circumvallate papilla. Between 6 and 24 months in the mouse, the number of taste buds per papilla decreased by 25% (Conger & Wells, Radiation Res. 37:31-49, 1969). Since we did not use the same method as Conger and Wells for counting taste buds, procedural variables may account for the differing results. We will extend our study in rat by replicating and evaluating the Conger-Wells procedure. Our data also contrast with reports of age-related decreases in number of taste buds in human circumvallate papillae dissected from cadavers (e.g., Arey et al., Anat. Rec. 64:9-25, 1935). Recently, however, Arvidson found no change in numbers of taste buds in fungiform papillae from humans aged 2 days to 92 years (Scand. J. Dent. Res. 87:435-442, 1979). Since some investigators have attributed reported loss of gustatory acuity in older individuals to loss of taste buds, it is important to pursue studies of possible age-related changes in taste organs and attempt to resolve some of the discrepancies in the literature.

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CONTROL OF SWEET SOLUTION MEALS IN THE RAT: HOW SWEET IT IS, NOT HOW GOOD IT IS. Douglas G. Mook and Cathy L. Wall, University of Virginia, Charlottesville, Va.

Rats that are hungry but not thirsty treat sweet solutions as foods. Over the lower concentrations (up to about 1 M sucrose or 1.5 M glucose), all rats prefer the higher of two carbohydrate concentrations. At higher concentrations, preference becomes more variable, some rats choosing the lower of two concentrations. This remains true when taste is isolated, and postingestive events held constant regardless of choice, by use of an esophageal fistula. In single-bottle tests, however, such rats always take larger "meals" the higher the concentration of sugar presented to the mouth.

Therefore, whereas at least some rats prefer the lower of two high sugar concentrations, they take larger meals when offered the higher one; and this happens when both the choice and the volume intake are determined by mouth factors alone. In rat as in man, there is a "bliss point" beyond which sweetness continues to increase but palatability diminishes. By working at concentrations past that point (and by isolating taste), we dissociate sensory intensity (how sweet it is) from hedonic intensity (how good it is). And we show that it is sweetness, but not goodness, that determines the size of a sweet-solution "meal."

AN ELECTROPHYSIOLOGICAL PARAMETRIC STUDY OF THE STIMULATION VARIABLES AFFECTING THE OLFACTORY NERVE RESPONSE. M.M. Mozell, P.R. Sheehe, S.W. Swieck (SUNY, Upstate Med. Cntr., Syracuse, N.Y. 13210), and D.E. Hornung (St. Lawrence U., Canton, N.Y. 13617)

The stimulation variables to which the magnitude of the olfactory response has most often been related is concentration but the effects of flow rate and, to a lesser degree, delivery rate have also been considered. However, these three variables are derivatives of three more primary variables, viz., number of odorant molecules (N), the volume of the vehicle (V), and duration of the presentation (T). Concentration (C) is then given by N/V, flow rate (F) by V/T, and delivery rate (D) by N/T. Thus there are a number of primary and derived variables to which, either singly or in a variety of different sets, the olfactory response magnitude could possibly be related. These relationships could become even more complicated if, in their impact upon response magnitude, these variables were to interact significantly with each other.

In an initial approach to disentangle these relationships we have evaluated the capacity of these variables, both singly and in all possible sets of two and three, to indicate the summated multiunit discharges recorded from the frog's olfactory nerve. The odorant (octane) was presented at two levels of "sniff" volume (V) and two levels of "sniff" duration (T) such that these levels were in 2:1 ratios and fell within the frog's normal repertoire. Likewise given at two levels in a 2:1 ratio was the number of molecules (N), and these levels were chosen from our earlier work to give midrange responses. Thus, we presented eight different combinations of N, T and V which in turn defined three levels each of C, F and D with each level being twice its predecessor. All 2^3 combinations of primary variable levels were randomly assigned in a factorial design to each of seven frogs and an analysis of variance was performed on the logarithms of the data.

The effect of each primary variable was highly significant (p=nil). No single primary (N,V,T) or derivative (C,F,D) variable adequately accounted for all of the effects. The effect of doubling was greatest for N and next greatest for C, but C was the best single indicator of significant effects (because there were three levels of C but just two of N). The best, as well as adequate, two-variable indicator of significant effects was [N,F], but the next best, [C,T], was not significantly worse than [N,F] ($p>.05$). The observed effect of doubling N or C was substantially greater at high V than at low V, but neither this nor any other interactive effect was significant ($p>.05$). Future experiments will be designed to consider how the physical and anatomical properties of the olfactory passageway might interplay with stimulation variables and how well the peripheral olfactory process is represented by the summated multiunit discharge. (Supported by NIH Grant NS03904)

EFFECTS OF AGING ON CHEMOSENSORY PERCEPTION OF BLENDED FOODS. Claire Murphy. Monell Chemical Senses Center, 3500 Market St., Philadelphia, PA 19004

Clinicians have occasionally used samples of food, usually in a form which minimizes texture cues, to evaluate problems of anosmia. Schiffman (J. Gerontology, 1977, 32, 586-592) has adapted this technique in an attempt to assess the gustatory problems of the elderly. In her studies, college-aged controls were significantly better at identifying the group of 24 foods. Difficulty in identifying blended foods could result from several factors: olfactory, trigeminal, gustatory or cognitive. To investigate the influences of these factors, a series of studies was conducted Subjects were either 18-26 or over 65 years. All were ambulatory, non-institutionalized, and, within the last year, non-hospitalized Stimuli were 12 items chosen from the list used by Schiffman, freshly cooked without seasoning, blended or thickened with cornstarch, and presented at a constant temperature. In the first experiment, each blindfolded subject was asked to identify the blended foods on the basis of taste and smell. He was given one exposure to each stimulus with no feedback and then as many sessions with feedback as were necessary to reach perfect performance, or ten sessions, whichever occurred sooner. Young subjects were significantly better than the elderly at food identification, both on the first exposure and after feedback. With extended practice, all subjects improved their identification abilities. By the fifth session, the various groups of college students (males, females, smokers, non-smokers) averaged between 98% and 100% correct and the elderly non-smokers averaged 94% correct. Elderly smokers did not improve as much: females averaged 85%, males 70% correct. In a second experiment, subjects were asked to identify the blended foods with the nostrils pinched closed (i.e. without the aid of olfaction). The task was equally difficult for young and old on the first exposure: ANOVA revealed no differences in percent correct overall or for individual food items. Both cognitive and sensory factors contributed to the ability to identify the blended foods, since performance in the open-nostril condition could be significantly improved with practice and feedback. However, blocking olfaction in all subjects resulted in scores for young and elderly which were essentially the same as the average score for the elderly in the open-nostril condition (41%). These data support the hypothesis that sensory differences between elderly and young subjects in the ability to identify blended foods can be ascribed largely to a deficit in olfaction or the trigeminal sense, rather than in taste.

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ODORANT RELATED 2-DEOXYGLUCOSE UPTAKE IN THE SALAMANDER OLFACTORY EPITHELIUM. Muriel H. Nathan and David G. Moulton. V.A. Medical Center and The Department of Physiology, University of Pennsylvania, Philadelphia, PA. 19104.

The 2-deoxyglucose (2DG) technique permits evaluation of relative levels of metabolic activity in the central nervous system. This procedure was used to assess the odorant related activity in the tiger salamander olfactory epithelium during odor stimulation.

Odorants, diluted by a purified airstream (500 ml/min.), were delivered to the ventral olfactory epithelium via a large pipette (id 4mm) positioned 1-3 mm above the receptor sheet on one side of the nasal cavity. A vacuum line removed odorant from the area. Odorants were delivered intermittently, for 53 seconds out of every minute. After a prestimulation period of 10 minutes, the salamanders were injected with either ^{3}H-2DG (2μCi/gBW) or ^{14}C-2DG (5μCi/100gBW) and further stimulated with odorant for 90 minutes. The animals were then decapitated; right and left epithelia and brains were frozen in liquid Freon (- 70°C) and sectioned in the cryostat (-30°C). Sections (16μ) were prepared from the ^{14}C-2DG animals for film autoradiography, whereas sections (5μ) from the ^{3}H-2DG animals were placed on emulsion-coated (NTBII) slides. Films were developed after 14 days of exposure and analyzed by computer densitometry. Slides were developed after 4 weeks and inspected with dark- and light-field microscopy.

Epithelia exposed to limonene showed a posterior focus of increased 2DG uptake, whereas control epithelia or those exposed to butanol or propanol did not. The film images read by densitometry showed that anterior and posterior areas on control epithelia were not significantly different, while several limonene-exposed animals showed anterior-posterior differences in 2DG uptake.

The presence of an active focus in the epithelium lying adjacent to the internal naris after limonene stimulation confirms electrophysiological data obtained in this laboratory (Kubie, Mackay-Sim and Moulton, Olfaction and Taste VII, 1981).

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FLAVONOID STIMULANTS OF INSECT BEHAVIOR. Dale M. Norris. 642 Russell Laboratories, University of Wisconsin, Madison, WI 53706

Flavonoid aglycones are important stimulants of insect behavior. Results from bioassays of several flavonoids for effects on Scolytus multistriatus feeding indicated correlations with (1) the oxidation state and/or (2) functional groups on the C_3 (propane) portion of the molecule. The flavan-3-ol, (+)-catechin, excited insect feeding. Such a compound involves the most highly reduced C_3 unit found in flavonoids and the presence of hydroxyl substitution, but the absence of a carbonyl. Two dihydrochalcones, phloretin and 2',6'-dihydroxy-4'methoxy dihydrochalcone, that have relatively reduced C_3 units which lack hydroxyls but each have a carbonyl proved allomonic (i.e., inhibitory) to insect feeding. Two additional flavonoids, kaempferol and quercetin, that are among the most highly oxidized flavonols were highly inhibitory to insect feeding. They were significantly ($P < 0.05$ or 0.01) more allomonic than the two tested dihydrochalcones. Our findings seem to indicate that the shift in state of oxidation of the propanoid unit of flavonoids from highly reduced to highly oxidized is accompanied by a change in elicited insect behavior from excitation to inhibition. Presence of a hydroxyl and/or carbonyl on the C_3 unit apparently secondarily influences the behavior elicited. (Research supported partially by N.S.F. grants No. BNS74-00953 and PFR77-08279.

ON THE HAMSTER'S RESPONSE TO TASTE MIXTURES. Geoffrey H. Nowlis. Rockefeller University, New York, NY 10021. Marion E. Frank. School of Dental Medicine, University of Connecticut Health Center, Farmington, CT 06032.

Taste stimuli containing two or more taste qualities may be analyzed by the gustatory system into their component qualities, or the sensations may be synthesized into a new taste quality different from either of the component qualities. The paucity of taste quality adjectives (sweet, salty, sour and bitter) may be viewed as indicating that there are only these four taste qualities; it is also possible that the language is simply not as rich as is human taste experience. If there were a new quality synthesized from, say, a sweet-salty mixture different from either component quality, but for which there were no appropriate adjective, those human psychophysical experiments dependent on the use of adjectives may fail to discern a new quality, and falsely conclude that the mixture is analyzed into the two components for which there are good adjectives.

Experiments with hamsters, without the use of taste-quality adjectives (we have not yet learned the hamster vocabulary adequately to discern which adjectives they use for taste qualities), eliminate this criticism. Hamsters are exposed for one or two weeks, one hour a day, to one of the components of a taste mixture, rendering this taste stimulus non-novel, and hence non-salient for use as a CS in a taste aversion. Animals are then given a taste of the appropriate mixture and then are made ill. Animals without pre-exposure to one of the components show a strong aversion to the mixture, and a lesser, but noticeable aversion to each of the components. Animals conditioned with the mixture after the pre-exposure to one of the components show weak, if any, aversion to the non-novel component, but show an aversion to the novel component which is just as strong as the aversion they show to the mixture. This is the case for the mixture of NaCl and sucrose and for the mixture of acetic acid and quinine. Presumably the aversion to the mixture, which was used as CS, would be stronger than the aversion to the novel component if its component qualities were synthesized into a new taste quality. Results are more complicated for the mixture of HCl and quinine, and we attribute this to the fact that HCl seems to taste both bitter and sour to the hamster (by other experimental criteria). So far we conclude that hamsters analyze taste mixtures into their component qualities.

STUDIES OF DOPAMINE AS A NEUROTRANSMITTER IN THE TURTLE OLFACTORY BULB. Martha C. Nowycky, Norbert Halasz and Gordon M. Shepherd. Section of Neuroanatomy, Yale Univ. Sch. of Med., New Haven, CT. 06510.

Several recent studies have indicated that dopamine (DA) is present in part of the periglomerular cell population in the rat olfactory bulb, and may serve a neurotransmitter or neuromodulatory function (Hökfelt et al, Neurosci. Letters 1: 85, 1975; Halasz et al, Brain Res. 154:253, 1978; Priestley et al, Brain Res. 165: 149, 1979). In the course of physiological studies of the isolated turtle olfactory bulb, we have carried out preliminary studies of the possible role of dopamine in this structure.

Single volleys in the lateral olfactory tract (LOT) or olfactory nerves (ON) generate large field potential responses in the olfactory bulb (Nowycky et al, Soc. for Neurosci. Abstrs. 4: 583, 1978; Waldow et al, Brain Res. in press). Dopamine was added to the Ringer solution in the bath in concentrations of 10^{-6}M to 10^{-5}M. In the presence of DA, there was an increase in latency, and a slight decrease in peak amplitude, over most of the concentration range, with a steep fall in amplitude at the highest concentrations. The conduction velocity of the ON was not affected by DA. Using paired volleys, there was a profound and prolonged depression of responses to the test volley, over periods of several seconds, as previously reported. In the presence of DA there was less depression of the test response. The dopamine agonist apomorphine (10^{-5}M) caused similar effects as DA. The dopamine antagonist fluphenazine (10^{-5}M) in contrast was associated with a decreased latency and an increase in amplitude of single responses; with paired volleys, there was increased suppression of test responses, especially with LOT stimulation.

The uptake of ^{3}H-dopamine in the isolated turtle olfactory bulb has been studied with autoradiography. Under light microscopy the greatest amount of labelling was seen in the glomerular layer, within the glomerular neuropil and also in cell bodies surrounding the glomeruli. Heavy labelling was also seen over terminals in the granule layer and the periventricular region. These results are similar to those previously reported in the rat. The labelled structures showing affinity for catecholamines may modulate the inhibitory responses as revealed in the physiological studies.

DETECTION OF PETROLEUM HYDROCARBONS BY CRABS.
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The abilities of the Dungeness crab, Cancer magister, and the blue crab, Callinectes sapidus, to detect petroleum hydrocarbons were assessed with behavioral techniques. When presented with a water-soluble fraction of Prudhoe Bay crude oil, both crabs abruptly changed antennular orientation and increased antennular flicking rate. These changes in antennular behavior were the same as those observed when crabs were presented with food extracts and were used to determine the percentages of crabs detecting various concentrations of petroleum hydrocarbons. The threshold concentrations at which 50% of the crabs detected the water-soluble fraction were 4×10^{-4} mg/l for the Dungeness crab and 2×10^{-6} mg/l for the blue crab. Both crabs apparently detect petroleum hydrocarbons at concentrations below those found in oil spills. Detection of petroleum hydrocarbons by the two crabs indicates that chemoreception by these crustaceans is not restricted to pheromones and chemical food cues, and supports Ache's (1975) suggestion that the chemical spectrum sensed by decapod crustaceans is really quite broad.

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CHANGES IN VOLATILES OF BOVINE VAGINAL FLUIDS IN RELATION TO ESTRUS.
George Preti[1,2], Charles A. Kiddy[3], Henry J. Lawley[1] and James G. Kostelc[1].

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It has long been felt that bulls use olfactory cues to determine the time of estrus/ovulation in cows. Recent studies by the United States Department of Agriculture (Beltsville, MD) employing trained dogs, show that these animals can differentiate odors from the vaginal secretions of estrus and non-estrus cows. Hence, a qualitative and/or quantitative change in the the volatiles from this source is characteristic of estrus. This change in odor can be identified by a "biological detector" (i.e., the dog) and should be amenable to characterization by gas chromatography (GC) and gas chromatography-mass spectrometry (GC/MS). We have been employing these instrumental techniques to determine which organic compounds in the vaginal secretions and milk of cycling cows appear and/or change in concentration during estrus.

Investigation of bovine vaginal fluids shows that the gas chromatograph patterns obtained from extracts of estrus and non-estrus samples are not very different. These samples were collected on specially prepared tampons with subsequent extraction of the organic materials using a continuous overnight extraction. The extract was then concentrated and directly injected. Only quantitative changes in the constituents were constantly seen in these samples. These results suggest that intravaginally produced compounds are diluted during estrus possibly due to increased amounts of cervical mucus.

Volatiles collected from the headspace above estrus samples are both qualitatively and quantitatively different from non-estrus samples. The differences seen are in the type and amount of C_6-C_7 alcohols (saturated and unsaturated) and may provide the basis for distinguishing between estrus and non-estrus via olfaction and via instrumental means. The headspace from estrus and non-estrus milk and vaginal samples were also assayed for volatile sulfur compounds with preliminary results indicating a difference between the milk samples.

CONDITIONED AVERSION TO A TASTE PERCEIVED WHILE GROOMING.
Russell F. Reidinger, Jr. and Gary K. Beauchamp, Monell Chemical Senses Center, Philadelphia, PA 19104. First author is a Biologist for the U.S. Fish and Wildlife Service.

Grooming behavior is used in rodent control. Tracking powders or dusts containing a toxin are sprayed into infested areas (e.g., within walls of a building). The material subsequently adheres to the feet and fur of rodents, and is ingested when the rodents groom. While reports in literature on rodent control suggest that grooming is a robust behavior that persists in the presence of a noxious taste, grooming/taste aversion interrelations have not been systematically studied. Here we report the results of five studies on this interrelationship. We believe the findings will contribute to improved rodent control and will add to our current understanding of taste aversions and grooming behavior.

In Experiment 1, saccharin was mixed with a "neutral-tasting" jelly and applied to the fur of male Sprague-Dawley® rats. Rats injected with LiCl after the applications strongly avoided saccharin solutions in subsequent 1-hr, 2-choice (saccharin solution versus water) drinking tests, whereas rats injected with NaCl or given plain jelly on the fur showed only an initial neophobic response to the saccharin solution. The results indicated that the taste of saccharin was perceived while grooming and that the taste aversion formed in the grooming context had generalized to drinking. In Experiments 2-5, we obtained evidence that: (a) the rats discriminated between one intensity of saccharin applied to the fur and another used in the test solution; (b) preexposure to saccharin applied to the fur reduced the strength of avoidance; (c) rats differentiated between qualities of two tastants applied to the fur in that one stimulus overshadowed the other; and (d) taste qualities were more important than toxic properties when two stimuli (saccharin, LiCl) were applied to the fur (saccharin overshadowed NaCl in subsequent drinking tests).

Overall, our results support the notion that a taste alone paired with post-ingestional illness is sufficient to condition an aversion and can be used to argue against the notion that taste aversion requires object learning. Our results suggest that grooming might have uses in rodent control not previously considered: e.g., in prebaiting (wherein the rodent becomes familiar with the taste of a bait formulation before actually encountering it); or, in delivering a non-attractive, low-salience toxin, and inducing crop aversion (when rodents are an agricultural pest).

DISTRIBUTION OF ZINC IN THE TASTE BUD REGION OF TWO VERTEBRATE SPECIES AS SHOWN BY X-RAY MICROANALYSIS.
+Klaus Reutter. Department of Anatomy, University of Tuebingen, Oesterbergstr. 3, 74 Tuebingen, FRG.

In man, the trace metal zinc seems to be necessary for normal functioning of the taste system and taste acuity (1, 2). Zinc deficient diet decreases human taste acuity and in the rat leads to degenerative processes in tongue epithelium involving taste buds (TB), (3). Although zinc deficiency in humans is known to cause hypogeusia and ageusia, it is still not clear where zinc is actually required, i.e., within the TB region, or the taste signal conducting nerves of the peripheral nervous system, or the corresponding tracts or nuclei of the CNS, or a combination thereof. The required zinc seems to be integrated into a protein (1-3).

The present investigation is restricted to the most peripheral part of the gustatory system, the TB. We compared data of two structurally different, but well known organs, the TB of the bullhead (Ameiurus; teleostean fish) and the TB of a mammal, the rabbit. Preparations destined for x-ray microanalysis were processed as follows. After anesthesia, the barbels (fish) and foliate papillae (rabbit) were rapidly removed and frozen in undercooled liquid nitrogen. Thereafter the specimens were broken into small pieces under liquid nitrogen, and the pieces were transferred into a deep temperature freeze-dryer. After drying, the specimens were mounted and coated with carbon and analyzed in a scanning electron microscope, equiped with an x-ray-microanalyzer. In some cases, the surfaces of the fractures in barbel pieces and foliate papillae represent longitudinal sections of TB. Thus x-ray microanalysis can be performed in distinct TB regions. Currently, zinc appears to vary considerably in different regions around and within both a bullhead TB and a rabbit TB. But as a rule, the zinc signal in a TB region exeeds that of neighboring tissues. Therfore zinc appears to be essential to intact peripheral gustatory processes.

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CHEMORECEPTION IN NASCENT OYSTER DRILLS: CHARACTERISTICS OF DISTANCE CHEMOATTRACTANTS. Daniel Rittschof, Leslie G. Williams, Robert Shepherd, and Melbourne R. Carriker. College of Marine Studies, Lewes, DE 19958

Newly hatched oyster drills (Urosalpinx cinerea) must travel from their egg cases, which are deposited on bare substrata, to their first meal. The prey of these numerous and pernicious marine predatory snails are a variety of shelled sessile and virtually sessile organisms including oysters and mussels. Location of prey is facilitated by chemoreception. Molecules released by living intact prey stimulate the nascent drill to creep up current. Movement of recently hatched drills was used to bioassay the chemoattractant substances. Each test snail was used once and discarded. Both creep rate (snail cm/min) and percentage of snails responding were dependent upon the strength of the stimulus. At flow rates between 4 and 360 cm/min there was an increase in both creep rate and % response with increasing stimulus concentration. At low flow rates (1.7 cm/min) high stimulus concentrations were inhibitory. The response of over 30,000 newly hatched, unfed, and therefore inexperienced drills to potential stimulus sources was tested. Of the 25 sources tested, only Balanus barnacles and a mixture of two bryozoans species produced an effluent which was highly attractive to the naive predators. The barnacle stimulus is a heat stable material with a molecular weight betwen 1,000 and 10,000 Daltons. It will bind to acid washed cellulose, but not to base washed cellulose. The material binds best to Amberlite XAD-7 Resin, but not to Amberlite XAD-2. Reversed phase high performance liquid chromatography was performed in various stimulus preparations and potential stimulus compounds were identified. The substance(s) appears to be a discrete chemical "word" rather than a chemical "picture." This work was supported by Sea Grant Funding (R/B-13).

FUNGIFORM VS. CIRCUMVALLATE PAPILLAE: IDENTIFICATION OF TASTANTS AND PSYCHOPHYSICAL EXPONENTS. Barbara L. Sandick and Armand V. Cardello. US Army Natick R & D Laboratories, Natick, MA 01760

A wide range of concentrations of compounds representing the four basic taste qualities were applied to single fungiform papillae and single circumvallate papillae. NaCl elicited salty responses from subjects when applied to fungiform papillae but not when applied to circumvallate papillae. However, NaCl elicited a strong sensation of bitterness and sourness when applied to circumvallate papillae at high concentrations and of sweetness at low concentrations, demonstrating excitation of other receptors. QHCl, on the other hand, was misidentified when applied to single fungiform papillae, whereas it was unambiguously perceived by subjects as bitter when applied to circumvallate papillae. Differences in taste quality identification for citric acid and sucrose were not marked, although a salty component was present in response profiles for citric acid when applied to fungiform, but not to circumvallate, papillae. These results suggest non-random distributions of bitter and salty receptors between fungiform and circumvallate papillae.

A second experiment compared the rate of growth of sensory magnitude with increasing concentration for sucrose and QHCl when applied to single circumvallate papillae, single fungiform papillae, and small areas of the anterior tongue. Power functions fit the group data well ($r^2 > .84$). The slopes (m) for the response to sucrose plotted in log-log coordinates were highest for circumvallate papillae (m=.58) and lowest for fungiform papillae (m=.32). The slope produced by stimulation of small areas of the anterior tongue (5-10 fungiform papillae) was intermediate to these two (m=.47). Subjects generally perceived QHCl as more intense when applied to circumvallate papillae than when applied to fungiform papillae. However, the slope was lower on these papillae (m=.23) than on fungiform papillae (m=.39) or on small areas of the anterior tongue (m=.31).

A Structural Study of a Proposed Chemoreceptor on the Gills of Limulus polyphemus. Jack Schlein and Gary Leonardi York College, Jamaica, N.Y. 11451

A small spine located on the inner lobe of each half gill of Limulus polyphemus has been examined by light microscopy, transmission electron microscopy and scanning electron microscopy. The spines are structurally almost identical to the gnathobase spines located around the mouth in Limulus (Hayes 1966,1971). The gnathobase spines have been shown behaviorally and electrophysiologically to be chemoreceptors by Barber (1956). Clam extract and glycine elicit definite responses when applied to these spines.

Characteristic structures found in the gnathobase spines include; cuticular tubules containing dendrites ; ciliary segments of the dendrites with a 9+0 microtubular arrangement; supporting cells identified as cuticulo-tubal cells and microvillar cells (Hayes, 1971). All of these structures have been located in the gill spines and their appearance is identical to those of the gnathobase spines. In addition, scanning electron micrographs of the gill spines show small papillae on the surface with a clearly visible pore. The cuticular tubules terminate in these papillae and it is through them that the dendrites are exposed to the external environment. To this point behavioral and electrophysiological experiments have provided only equivacol results with these chemoreceptor sensilla. Clam extract glycine, seawater of various strengths, "male" and "female" seawater, seawater saturated with C02, seawater saturated with 02, seawater with reduced 02 all have been tested with no conclusive results. Currently a y-shaped maze is being employed to determine if chemotactic responses are present.

DISCRIMINATION BETWEEN MITRAL AND TUFTED CELL EXTRACELLULAR SPIKES IN THE RAT OLFACTORY BULB BY ANTIDROMIC ACTIVATION. Stephen P. Schneider and John W. Scott. Department of Anatomy, Emory University, Atlanta, GA.

Despite anatomical evidence for a laminar distribution of olfactory bulb (OB) output neurons, electrophysiological identification of mitral (M) and tufted (T) cells has been made difficult by the concern that extracellular spikes recorded in the external plexiform layer (EPL) may result from propagated action potentials in M cell dendrites. Accurate identification of output neuron classes would be valuable in comparative studies of M and T cell physiology. We have used anatomical observations of T cell projections as another basis for discriminating between M and T cell spikes. OB units were recorded in two independent groups of rats in which anesthetics and electrode configurations were varied. Irrespective of experimental conditions, output neurons with different axonal projection patterns formed different but overlapping laminar distributions in the OB. Units which were antidromically driven only from the posterior piriform cortex (pPC) and those (pPC-OT) which were activated from both the pPC and olfactory tubercle (OT) were distributed in or near the mitral cell body layer (MBL). Units (OT-only) activated from the OT but not from the pPC occupied a more superficial position, averaging 129μ from the MBL. A fourth class of OB units (LOT-only) were antidromically activated only from the lateral olfactory tract (LOT) at the level of the olfactory peduncle. LOT-only units were distributed superficially to the OT-only units and averaged 240μ from the MBL. The laminar distributions of pPC-OT, OT-only, and LOT-only units were statistically different ($p<.01$). Analysis of antidromic response latencies to LOT stimuli revealed small but significant differences between pPC-OT and OT-only groups as compared to the LOT-only units ($p<.01$). Our results are consistent with anatomical observations of M and T cell projections based on HRP studies and suggest that under these recording conditions the preponderance of antidromic spikes in the EPL are recorded from T cells. We conclude that laminar position and axonal projection patterns defined by antidromic activation are sufficient information to distinguish classes of OB output neurons.

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NO EVIDENCE FOR FUNCTIONAL DEFICITS FROM EARLY X-IRRADIATION OF RAT OLFACTORY BULBS. Frances W. Schoonover and Burton M. Slotnick, The American University, Washington, D.C. 20016

Walters and Struble (Soc. Neurosci. Abst., 1978) reported that rats receiving postnatal X-irradiation of the olfactory bulbs show, as adults, a variety of alterations of olfactory bulb morphology. These include an 80% reduction in the volume of the main olfactory bulb, reduction in the size of all bulb layers, abnormalities of mitral cell shape and dendritic field, and a marked reduction in number of granule cells. Preliminary behavioral tests by Walters and Struble suggested that these animals were not anosmic but would respond to buried food, the odor of a cat, and showed no deficits in the acquisition of an olfactory mediated Y-maze task.

We here report the results of olfactory function tests on two experimental rats provided for us by Walters and Struble. The animals were trained in our wind-tunnel olfactometer to detect a .5% (of vapor saturation) amyl acetate odor and then tested for absolute threshold. In addition, an olfactory intensity difference threshold was determined in one animal and the other rat was tested for acquisition of a 2-odor problem (ethyl acetate vs isopropyl acetate). Because these animals remained in a fragile state of health, occasionally showed erratic behavior and instances of response extinction, careful feeding was necessary and a strict training schedule could not be followed. Despite these problems, performance accuracy for the acquisition of the detection problem, psychophysical measures, and 2-odor discrimination was well within the range observed for normal rats. The olfactory bulbs of these animals were greatly reduced in size compared to normal controls and preliminary histological analysis revealed changes in the granular cell layer including a marked reduction in dense staining cells and absence of the normal cellular organization within this layer.

Early X-radiation produces interesting changes in the anatomy of the olfactory bulb. Unfortunately, neither this study or the earlier report of Walters and Struble have revealed the functional consequences of these alterations in olfactory bulb morphology. However, it is clear that such animals can be trained on olfactory tasks and future studies, using more sophisticated tests, may reveal specific deficits related to the effects of this treatment.

UNIT ELECTROPHYSIOLOGY OF TASTE-MEDIATED BEHAVIOR IN THE PARABRACHIAL REGION OF THE RABBIT. Jerome S. Schwartzbaum and Christine H. Block. University of Rochester, Department of Psychology, Rochester, NY 14627.

A technique for the electrophysiological analysis of taste in the awake behaving rabbit will be described. Tests carried out in behaving rabbits with this technique, using 4 basic types of tastants injected intraorally, have revealed a variety of neural response patterns to tastants and to conditioned-type auditory stimuli that signal the delivery of the tastants. Some cells show selective patterns of response to tastants. Other cells display various conditional modes of reaction that antecede response to the tastants, while still others show relatively nonspecific modes of reaction to auditory and taste stimuli. Analysis also reveals different types of taste relationships to cellular patterns of activity linked to orolingual movement. Output mechanisms in the parabrachial region appear to be dynamically modulated by the palatability of "expected" tastants.

ODOR-ELICITED RESPONSES FROM THE RAT TRIGEMINAL NERVE. Wayne L. Silver and David G. Moulton. VA Medical Center; Clinical Smell and Taste Research Center and Department of Physiology, University of Pennsylvania School of Medicine, Philadelphia, PA 19104.

There are several different receptor types in the nasal cavity which are capable of responding to airborne chemicals. These include both olfactory receptors and trigeminal free nerve endings (Tucker, 1963). However, relatively little is known about the nature of the odor-elicited trigeminal response. Since stimulation of trigeminal receptors in the nose produces marked respiratory and cardiovascular changes, information about their sensitivity and discriminatory ability will help to determine the possible effects of odors on physiologic function as well as the role of the trigeminal system in the perception of odors. The purpose of the present study is to examine some of these properties of trigeminal chemosensitivity.

Integrated responses were recorded from the ethmoid branch of the trigeminal nerve in Sprague Dawley rats. Stimuli were presented at the external nares via an air dilution olfactometer or a syringe filled with odor impregnated cotton - a different syringe for each odor. The odor was drawn through the nasal passage by means of a nasopharyngeal cannula inserted into the trachea and connected to a vacuum line. Flow rate through the nose was kept constant at approximately 1000 ml/min. The vacuum was on for a period of about 30 seconds, in the middle of which an odor was presented for 10 seconds. The interstimulus interval was 3 minutes.

The integrated response exhibited an initial phasic component followed by a decline to a steady state tonic level. This response rapidly returned to base line levels after removal of the stimulus. Responses to several stimuli delivered with the syringe (amyl acetate, ethyl acetate, benzaldehyde, cyclopentanone, cyclohexanone, butanol, and acetic acid) were obtained in all animals tested. A response to phenyl ethyl alcohol was seen in only one of four animals. Responses to air alone were never observed. Using the olfactometer, thresholds were determined for amyl acetate and butanol. Amyl acetate below 130 ppm ($10^{-1.0}$% vapor saturation) and butanol below 164 ppm ($10^{-1.6}$% vapor saturation) did not elicit a response. (Supported by NIH grant No. 1 P01 NS 16365 01.)

ABSOLUTE OLFACTORY THRESHOLDS IN RATS AND HUMANS. Burton M. Slotnick. The American University, Washington, DC 20016

Absolute olfactory thresholds were determined for 4 adult male rats, 2 female and 2 male undergraduate students. Odors were generated by an air-dilution olfactometer. Rats were water deprived and trained in a wind-tunnel to respond to the presence of amyl acetate odor for a water reward. For human subjects, odors were presented via a nose cone and correct responses were signaled by illumination of a light. For both species a descending method of limits was used in which 50 trials (humans) to 100 trials (rats) were given in a single session at each odor concentration. If performance accuracy was 75% or greater in the last part of the session, stimulus concentration was reduced by .5 log units in the next session. For rats, training was terminated if performance accuracy was below 75% in 4 consecutive sessions of a given problem. Humans who failed to detect a given concentration were given additional training on a detectable concentration and retested on the next lower concentration.

Mean absolute threshold for rats was $10^{-7.2}$ (range: 10^{-8} - $10^{-6.8}$) of vapor saturation. Each rat maintained high levels of performance (85%-100% correct detection) until near-threshold concentrations were given. The absolute threshold for human subjects was $10^{-4.3}$ (range: 10^{-5} - 10^{-4}) of vapor saturation. Human subjects showed considerable variability in test-retest sessions and thresholds are based on best performance. Humans correctly judged when the odor was not detectable and asking them to continue trying, to guess, to adopt different sampling strategies, etc. had little or no effect on performance accuracy.

Our data suggest that, at least for amyl acetate, the absolute threshold of the macrosmatic rat is approximately 1000 times lower than the microsmatic human. Absolute threshold values obtained for rats were approximately 1.5 log units lower than those reported by Pierson (J. Comp. Physiol. Psychol., 1974) for the rat and are similar to thresholds reported by Moulton and Marshall (J. Comp. Physiol., 1976) for dogs tested on alpha ionone.

AN OPERANT PROCEDURE FOR ASSESSING TASTE FUNCTION IN RATS. Burton M. Slotnick. The American University, Washington, D.C.

A simple system for precise metering of tastants and a rapid method of training rats to use tastants as discriminative cues is described. A discrete trials go, no-go discriminative training procedure was used in which licking at a triple-barrel tube served as the operant response. An attending response, defined as making 8 licks at the tube, resulted in presentation of .005cc of the positive or negative tastant. On positive trials a .02 cc water reinforcement was contigent upon completing a DRH requirement (making 8 licks within 1.5 sec after delivery of S^+). Completion of the DRH after presentation of S^- resulted in a signaled time-out which terminated when the rat stopped responding for 3-sec.

Using 1% NaCl as S^- and water as S^+ rats perform at high levels of accuracy (licking at high rates after delivery of S^+ and pausing after delivery of S^-) in 3-4 200-trial sessions (approximately 1-2 hrs of training). Absolute threshold for NaCl was determined for 3 rats using a modified descending method of limits procedure. Mean absolute threshold was .0038% (range: .0031-.0043%). Acquisition of 2 tastant discriminations (including isohedonic solutions) occurs in 1-2 training sessions.

The methods described are simple, effective in gaining stimulus control of responding and avoid the various shortcomings of using preference methods for assessing detectability and discriminability of tastants.

EFFECTS OF UNILATERAL BULBECTOMY IN RATS ON OLFACTORY THRESHOLDS. Burton M. Slotnick and Frances W. Schoonover. The American University, Washington, D.C. 20016

To determine the effects of unilateral olfactory bulb removal on odor sensitivity, adult male rats were trained in a wind-tunnel olfactometer on a simple odor detection problem, operated on (unilateral bulb removal, n=5; shams, n=5) and tested postoperatively on a series of intensity difference problems and for absolute threshold. A modified Moulton-type air dilution system was used for generating stimuli. A discrete trials go, no-go training procedure was used in which responding in the presence of the positive stimulus (S^+) was reinforced with water. Amyl acetate odor was used in all psychophysical tests.

For the intensity difference threshold tests a modified ascending method of limits was used in which the standard stimulus (S^+) was .5% of vapor saturation and .05%-.45% (in .05% steps) served as comparison stimuli (S^-) in separate test sessions. For absolute threshold tests the S^+ stimulus was decreased (beginning with .5%) in half log unit steps in separate sessions; the S^- stimulus was scrubbed air. For psychophysical tests, the next more difficult problem was given if the animal achieved a score of 75% correct in the last 60 trials of a 100-trial session. Training was discontinued if the animal scored lower than 75% on 4 test sessions of a given problem.

Results revealed surprisingly little difference between normal and unilaterally bulbectomized rats. Both groups showed near perfect retention of the preoperative detection task. The mean intensity difference thresholds for normals was .26 and for experimentals .3. The absolute threshold of experimental rats was only about .5 log units greater than normals. These results suggest that the major advantage of birhinal stimulation is not to greatly increase odor sensitivity. Birhinal stimulation may be more important for other olfactory functions such as adaptation and localization of odor sources.

THE EFFECTS OF VARYING BOTH US INTENSITY AND CS PREEXPOSURE LEVELS IN TASTE AVERSION CONDITIONING. Alan C. Spector, James C. Smith, and Glee R. Hollander. Florida State University, Department of Psychology, Tallahassee, Florida 32306

The purpose of Experiment 1 was to examine radiation induced taste aversion to saccharin using parametrically varied radiation exposures. The extent of the learned taste aversion was quantified using several dependent measures. On conditioning day, six groups of albino rats received a 10 minute presentation of a novel saccharin solution (0.1% w/v) followed by either a 0R, 25R, 50R, 100R, 200R, or 300R radiation exposure. An additional control group received water followed by a 300R radiation exposure. The results indicate that the severity and longevity of the aversion was directly related to the level of radiation exposure. The variation of scores within groups systematically decreased as the radiation exposures increased. Pairing water with a 300R exposure resulted in an enhanced neophobic response to saccharin which was quite profound with unusual longevity. The purpose of Experiment 2 was to examine the effects of limited saccharin familiarity on the conditioning of a saccharin aversion while parametrically varying radiation exposure. This experiment was similar to Experiment 1 except that all of the rats received two 10 minute presentations of saccharin on the two days prior to conditioning. The results show that the magnitude of the aversion was reduced compared to the groups in Experiment 1, but that the severity of the aversion was still directly related to the level of radiation exposure. It was found that the dependent measures used to quantify conditioning were differentially sensitive. Therefore, the subsequent conclusions were contingent upon which measure was accepted as an indicator of conditioning. There was no systematic reduction in the variance of scores within the groups related to the radiation exposure as was seen in Experiement 1. A discussion of the relative merits of the dependent measures used in Experiments 1 and 2 is included.

AGE DIFFERENCES IN THE CONTRIBUTION OF OLFACTION TO FLAVOR. David A. Stevens. Clark University and Food Science Lab., U.S. Army Natick Research and Development Laboratories, Natick, MA 01760

Young (18-25 yrs) and older (56-67) persons with natural dentition tasted purees of cantaloupe (CLP), peach (PCH), corn (CRN), green pepper (GP), spinach, and turnip (TRN), and rated them while holding a nose piece into the external nares. Either clean air or air odorized by puree was blown into the nares (3 l/min) while the food was tasted. Subjects rated each puree's flavor using ten scales and then identified the foods.

GP was rated saltier when odor was present than when it was not. The presence of odor increased the bitterness of TRN for the young, but decreased it for the older subjects. CLP, PCH, and GP were rated as more bitter by young than by older subjects. CLP was rated fruitier and PCH less fruity with odor present than when not for the young; the opposite was found for the old. GP and TRN has a more vegetable-like flavor with odor present than when not. The young rated the purees as generally less flat with the foods' odors present than when they were not present. The presence of a puree's odor increased ratings of strength of odor to a greater extent for young than for older subjects. The extent a puree was liked differed between age groups only for PCH; the young rated it higher than did the older subjects. Neither presence of odor nor age of subject affected the ratings of sweetness, sourness, smoothness or strength of flavor.

The presence of puree odor did not affect the accuracy of identification, which was generally low. Only CLP was correctly identified by more than half of the subjects of both ages. CRN was similarly identified by the young but not the older people.

These results show that there are important age differences in the effects of olfaction on flavor. Further, food odors do not simply strengthen flavor qualities, but affect flavors in a complex way.

EVIDENCE FOR CHEMICAL COMMUNICATION IN SEA LAMPREYS. John Teeter. Monell Chemical Senses Center, 3500 Market Street, Philadelphia, PA 19104

The responses of spawning-run landlocked sea lampreys (Petromyzon marinus) to substances released by conspecifics were observed in two-choice preference tanks. Both sexually mature males and females exhibited preferences (presumably olfactory) for water in which sexually mature sea lampreys of the opposite sex had been held. No preference was observed when females were tested with water in which other females had been held, while males avoided water from tanks containing other sexually mature males, indicating that the observed preferences for the opposite sex were specific responses to different substances released by males and females, not a generalized response to the scent of other lampreys. Neither sexually immature males nor females showed preferences for rinses of immature lampreys of the opposite sex, indicating that the release of the apparent attractants and/or the responsiveness of the receiving animals were correlated with sexual maturation.

The apparent attractant released by males was present in urine. Urine from sexually mature males elicited a preference response in females at concentrations down to about 12 µL/L of water in the test tank, while skin mucus, milt (6.4 to 51.2 µL/L), and urine from sexually immature males (12.8 to 51.2 µL/L) were ineffective. The attractant released by females appeared to be associated with ovarian fluid.

These results suggest that both male and female sea lampreys, after reaching a certain stage of sexual maturation, release substances which signal their sex and reproductive state. These signals could be involved in aggregation prior to or during upstream migration, dispersion of males over the available spawning habitat, pair-formation and maintenance, or release of spawning behavior.

In addition, male sea lampreys, captured at the beginning of a spawning migration prior to the appearance of secondary sex characters, showed preferences for water in which sea lamprey larvae had been held. This suggests the possibility that chemical signals, originating from the resident population of sea lamprey larvae in a river, may aid upstream migrants in selecting a suitable stream in which to spawn.

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INTERNEURONS PROJECTING TO MOTONEURONS INVOLVED IN INGESTION AND REJECTION. Joseph B. Travers and Ralph Norgren. The Rockefeller University, 1230 York Avenue, New York, NY 10021

Midbrain decerebrate rats are capable of making ingestion or rejection responses to a gustatory stimulus similar to those of intact rats (Grill and Norgren, 1978). These ingestion or rejection responses involve muscles innervated by the trigeminal, facial, and hypoglossal nerves. The present investigation was undertaken to identify afferents to these motor nuclei that may be involved in ingestion and rejection. Small deposits of horseradish peroxidase (HRP) were iontophoretically delivered to the trigeminal (MV), facial (MVII) and hypoglossal (MXII) motor nuclei and the tissue processed with tetramethylbenzidine. Unlike projections from trigeminal sensory nuclei to these motor nuclei, direct projections from gustatory regions of the nucleus of the solitary tract (NST) or the parabrachial nuclei (PBN) appear to be lacking. Labeling in the reticular formation (RF) lateral to MXII was found bilaterally following HRP injections into MVII and primarily contralaterally following an injection into MV. Injections of HRP into this region of the RF and the adjacent MXII resulted in the label of an occasional anterior NST cell with many neurons found in the RF ventral to the NST. At more rostral levels, the ipsilateral Kolliker-Fuse and supratrigeminal regions showed retrogradely labeled neurons following motor nuclei injections. These areas are adjacent to the PBN. In the midbrain, the deep layers of the superior colliculus and midbrain reticular formation also showed retrogradely labeled neurons. It seems less likely that these neurons are directly involved in gustatory responses, however, as synapses of ascending gustatory axons have not been reported in the midbrain.

Grill, H.J. and R. Norgren. Brain Research 143: 281-297, 1978.

CHEMORECEPTION IN PARAMECIUM: RELATIONSHIP OF FOLATE TRANSPORT TO FOLATE ATTRACTION. Judith Van Houten, Mary DiNallo, Mark Wohlford*, Anastasia Bulloch*. Departments of Zoology, University of Vermont, Burlington, VT 05405, *University of Iowa, Iowa City, IA 52242

Paramecia detect some soluble chemicals and respond to them by accumulating in or dispersing from them. These chemical cues first make contact with the cell at the ciliary or plasma membrane and subsequently the chemical cue is transduced into a characteristic electrical signal. Membrane potential changes control slterations in ciliary beating, that, in turn, control population behavior. It is not clear whether cues generally must cross the membrane in order to directly cause membrane potential changes or whether they bind to membrane receptors and indirectly cause the changes in membrane potential through alteration of permeability to other ions.

Paramecia are attracted to folate. The characteristic electrical response to folate detection is a hyperpolarization. Since folate is an anion and cells have transport systems for this essential vitamin, folate could conceivably hyperpolarize the cell directly by crossing the membrane and entering the cell rather then indirectly by binding to receptor. Uptake studies of mutants specifically defective in response to folate indicate that defects in chemoreception are accompanied by defects in uptake. However, nutritional conditions exist under which normal cells show no measurable uptake but are normally attracted. Mutants resistant to folate analog methotrexate also are not attracted to folate, but show normal uptake of folate. Therefore, transport systems for folate appear to be involved in folate chemoreception, perhaps as membrane receptors, but actual transport of folate across the membrane is not necessary for chemoreception of and the characteristic electrical response to folate.

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FUNCTIONAL SEPARATION OF TASTE AND NON-TASTE BEHAVIORS IN OYSTER DRILLS. Victoria Vydec. University of Delaware College of Marine Studies, Lewes, DE 19958.

The functions of taste and smell in vertebrates are anatomically and appear to be functionally separate. Smell functions to monitor environmental surrondings and is innervated by the first cranial nerve. Taste, on the other hand, functions to either accept or reject substances which have been taken into the mouth, and reveives innervation from from other cranial nerves including the III, IV, and IX. In invertebrates the distinctions between taste and smell are difficult to make anatomically, and appear to be less clear at the functional level. I decided to test the hypothesis that in gastropods smell and taste could be separated at the functional level.

The hypothesis was tested with the aide of a known taste effector, monosodium glutamate, which has no known effect on non-taste mediated behavior. The response of starved oyster drills to oyster spat was used as an assay for taste mediated behavior and other non-taste behaviors were monitored in the course of the assay. At low concentrations of monosodium glutamate (MSG 10^{-9}-10^{-12}M) treated snails consumed significantly more oyster spat than did controls ($p = 0.01$) and there were no obvious modifications in non-taste associated behavior. At intermediate concentrations of MSG (10^{-6}-10^{-8}M) there was a sharp decrease in consumption by the drills and they began to secrete copious amounts of mucus. At still higher concentrations (10^{-3}-10^{-6}M MSG) feeding ceased and the snails performed what can only be described as a complex heirarchy of tasteless behaviors. In the first five minutes the snails secreted copious amounts of mucus and began to excrete unusual amounts of psuedofaeces. In the second five minutes the snails really defecated. Defecation was followed by a period of frenzied trail following and mucus consumption. This period ended abruptly and single, multiple and exponential multiple copulations ensued. Death of the resultant "daisy cahin" was at 30 min post MSG administration, presumably due to suffocation in the mucus.

The series of experiments described above was repeated on a second boring muricid gastropod, Oceanebra inornata. MSG evoked none of the behaviors mentioned above, nor did it alter the feeding response to oyster spat. However, a second taste effector, Massen Gill TP3H (strawberry) produced dramatic effects. Every dose tested (10^{-3}- 10^{-14}M) resulted in frenzied trail following, parapetetic proboscis extention, and slime trail search in males. There was a significant increase in food consumption in females. I hypothesize from these data that there is no accounting for tasteless behavior in muricid gastropods.

TASTE QUALITY RECOGNITION AND FORCED CHOICE PSYCHOPHYSICS.
James M. Weiffenbach National Institute of Dental Research
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Taste quality recognition thresholds commonly reflect not only the subjects' taste functioning but also their response criterion, their willingness to report recognition of a taste quality. In many sensory studies response criterion bias can be controlled by forced choice procedures. In such procedures, subjects must choose which of several temporal or spatial locations contains a target stimulus, and therefore, their willingness to report their perceptions is not a factor. Because the target stimulus is randomly assigned to the various locations, a subject's preference for guessing one location or another does not bias the result. Thus, the standard forced choice procedure both controls response criterion bias and avoids any systematic effect of the subjects' guessing behavior. However, since stimuli too weak to be recognized by quality may nonetheless be discriminated from blanks, performance under forced choice procedures may not reflect taste quality recognition.

V. Collings has developed an innovative method for obtaining recognition thresholds which shares some features with the four alternative variant of the standard forced-choice procedure. In the Collings procedure, single stimuli are presented on each trial and a response choice among the four quality names is forced. Response criterion bias is adequately controlled so long as responses indicating failure to recognize a taste quality are not accepted. Preferential guessing of taste quality names is uncontrolled, but problems arising from this potential source of bias have not been reported. However, using the Collings procedure, I find 1) significant disproportional representation of quality names among incorrect responses, 2) stable individual differences in preferred guesses and 3) increments in disproportionate responding from initial to subsequent tests. These data force an examination of the Collings procedure. Recall that the standard forced choice procedures do not eliminate preferential use of response categories but cancel the effects of guessing bias by randomly assigning stimuli to presentation locations and combining data from presentations which may have been positively and negatively affected. In the Collings procedure, stimuli cannot be presented under different conditions of response preference. The stimulus for which the most preferred response is correct is always more likely to be guessed correctly than the stimulus associated with the least preferred response.

TASTE DETECTION THRESHOLDS: CHANGES WITH POST ADOLESCENT DEVELOPMENT
James M. Weiffenbach and Bruce J. Baum. National Institute of Dental Research and National Institute on Aging, NIH, Bethesda, MD 20205

Detection thresholds for each of the four basic taste qualities were obtained from each of 42 men and 39 women ranging in age from 23 to 88. Subjects tasted 10 ml samples of distilled water solutions of sucrose, sodium chloride, citric acid and quinine sulfate. The strength of the test sample was determined by an up-down tracking procedure employing quarter log steps of concentration. Importantly, response criterion bias and the effects of adaptation to saliva were controlled by requiring subjects to make forced choice responses and to rinse with distilled water before tasting each sample. Both response criterion bias and the composition of saliva may vary with age and could have distorted the age functions generated by most earlier studies.

Grzegorczyk, Jones, and Mistretta (1979) are responsible for the only previous study which controlled for these influences. They tested only sodium chloride and analyzed their data in molar units. Expressing our sodium chloride data in these units, we find the linear regression of threshold on age to be similar to that reported reported by Grzegorcyzk et al. The agreement is increased if we follow their precedent and eliminate some unusually high thresholds from the analysis. However, a logarithmic transformation of the threshold values allows the data from all the subjects to be encompassed and at the same time, increases the goodness of fit associated with the linear model.

Logarithms were employed in a regression analysis of each tastant. Only sodium chloride and quinine sulfate demonstrated significant regression.

Separate age (3) x sex (2) analyses of variance were performed on the logarithm of the threshold for each quality. Sodium chloride shows a significant main effect for age, and men have significantly lower thresholds for citric acid than women. No other main effects or interactions reach statistical significance.

A previously reported progressive increase in sodium chloride threshold with age is confirmed. Quinine sulfate thresholds, are significantly related to age, but do not show age group differences by analysis of variance. No significant threshold changes are demonstrated for citric acid or sucrose. Thus, detection thresholds for the four taste qualities undergo quite different changes with age.

CHEMORECEPTION IN NASCENT OYSTER DRILLS: RESPONSE TO AGONISTIC STIMULI.
Les Williams, Dan Rittschof, Betsy Brown, and Mel Carriker. University of Delaware, Lewes, DE 19958

Urosalpinx cinerea is a marine shell-boring snail endemic to the Atlantic coast of the United States. Individual U. cinerea are stenotrophic predators that detect and select their preferred prey by chemotaxis. For instance, newly hatched, nascent, U. cinerea show a strong, innate, distance-chemotaxis to balanoid barnacles and bryozoans, and a weaker response to oysters and tube-dwelling polychaetes (Rittschof et al., 1981). Throughout its range, U. cinerea is a generalist predator of numerous species of bivalves, gastropods, barnacles, and bryozoans. Therefore, it is apparent that more species of prey are attacked by U. cinerea than can be explained by distance chemotaxis.

We hypothesized that nascent U. cinerea are compelled by negative geotaxis and distance chemotaxis to emigrate from the near subtidal location of their egg-capsules and move upward through the intertidal zone. During this migration, U. cinerea must move through bands of potential prey species that may emit chemical cues evoking contact rather than distance chemotaxis. To test this hypothesis, we compared the distance chemotaxis of snails to barnacle stimulus with that evoked by barnacle stimulus mixed with stimulus water from two other potential prey species, the mussel Mytilus edulis and the oyster Crassostrea virginica.

Our results show that mussel stimulus inhibits the distance chemotaxis of U. cinerea to Balanus eburneus. Oyster stimulus facilitates the chemotactic response of U. cinerea when mixed with dilute (1/50) barnacle stimulus, but inhibits the response when mixed with higher concentrations (1/10) of barnacle stimulus. Further experiments show that a two hour exposure of U. cinerea to barnacle stimulus nearly eliminates chemotaxis to barnacle stimulus. Two hour exposure to oyster or mussel stimulus significantly ($p < 0.05$) reduces the chemotactic response to barnacle stimulus. These results suggest that at least two prey species, C. virginica and M. edulis, of U. cinerea release similar, agonistic, stimuli that can compete with the distance chemoattractant released by the barnacle B. eburneus.

CHEMORECEPTION IN NASCENT OYSTER DRILLS: INGESTIVE CONDITIONING OFFERS THE BENEFITS OF TWO FEEDING STRATEGIES.
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Ingestive conditioning, defined as a "modification of the predator's responses to prey effluents...induced by maintenance upon single-species diets," has been shown to occur in a number of species from at least three phyla since it was first applied by Wood (1965) to the behavior in an olfactometer of juvenile and adult *Urosalpinx cinerea* Say. But until recently attempts to induce changes in the chemotactic responses of young, newly-hatched *U. cinerea* failed, partly because of the logistic difficulty of providing abundant prey animals small enough to serve as single-species diets for 1-mm snails, and partly because miniature olfactometers, suitable for testing the chemotactic responses of nascent snails, had not been devised. Both problems have now been solved. We cultured large numbers of *U. cinerea* capsules and oyster spat, and field-collected the other two prey species (barnacles and mussels) shortly after natural sets. To test the responses of young predators, we developed two olfactometers, each derived from a different concept. The activity chamber consisted of parallel, horizontal tunnels through which flowed either seawater alone or seawater labelled with prey effluent. A positive chemotactic response was defined as a significant difference between the upstream movement of stimulus and control snails. The second device was a four-choice circular chamber machined from a block of acryllic resin and patterned after the original Wood (1968) olfactometer. Flow rates were balanced in all experiments and observations were usually made through a dissecting microscope. Both devices were functionally validated by testing the effects upon unfed snails of seawater control *versus* the effluent from a mixture of common invertebrate prey species.

With the parallel tunnels we found that nascent, unfed *U. cinerea* were significantly more active in the presence of effluents from *Balanus spp.* than from either *Crassostrea virginica* or *Mytilus edulis*.

After feeding on single-species diets for 42 days, young *U. cinerea* were induced to respond preferentially to effluents from the species they had been eating. But *Balanus*-fed snails showed both a greater survival rate and faster growth rates than snails fed either oysters or mussels.

These results suggest that *U. cinerea*'s innate preference for balanid prey odor may be the result of an evolved and highly adaptive specialist feeding strategy and that the co-evolution of ingestive conditioning endows this very successful predator with the flexibility of generalist feeders in habitats which lack barnacles or from which barnacle populations sometimes disappear.

THE INFLUENCE OF CHEMOSENSORY SYSTEMS AND SOCIAL EXPERIENCE UPON MALE MOUSE COURTSHIP VOCALIZATIONS. Charles J. Wysocki[1], John Nyby[2], Glayde Whitney[3], Susan Erisman[1], Ronald Bernhard[4] and Donna Crouthamel[1]. [1]Monell Chemical Senses Center and [4]University of Pennsylvania, Phila., PA 19104, [2]Lehigh University, Bethlehem, PA 18015, and [3]Florida State University, Tallahassee, FL 32306

Male mice emit 70kHz courtship vocalizations during encounters with female, but not male, mice and, if socially experienced, during exposure to female, but not male, urine. We investigated chemosensory control over the emission of ultrasounds in a series of studies.

Male mice underwent bilateral (BOBX) or unilateral (UOBX) olfactory bulb removal or a sham surgery. After recovery, each mouse was tested for its responsiveness to male and female mice and soiled cage shavings from group housed females. Sham and UOBX mice emitted more vocalizations to females than to males, while BOBX mice emitted fewer vocalizations overall and failed to discriminate males from females. While female-soiled bedding elicited responses from both sham and UOBX mice, BOBX mice were silent.

In a second study, male mice received either $ZnSO_4$ or saline intranasally prior to repeated vocalization tests with male and female stimuli. After an initial low response to both males and females, $ZnSO_4$ treated mice increased their responsiveness to females and maintained a male-female discrimination equivalent to saline treated mice. A repeated independent test of olfaction revealed a persistent deficit in olfactorally mediated abilities.

In a third experiment, males who had social interactions with females underwent either sham surgery or had their vomeronasal organs removed (VNX). Each mouse was later tested with males, females, or their urines. Sham males discriminated between males and females and between their urines. However, VNX mice, although maintaining a slight male-female discrimination, increased their responsiveness to males and dramatically decreased their responsiveness to female urine. Non-vomeronasal cues, some learned during social experience, may have maintained the behavior. To test this hypothesis, a fourth study was conducted, in which socially inexperienced mice were tested.

Males, lacking adult experience with females, were subjected to either sham or VNX surgery and later tested for their responsiveness to anesthetized males and females and their urines, both before and after social experience. Sham mice responded to females, but not to males, during all tests and, after social experience, to female, but not to male, urine. VNX mice did not discriminate between males and females, produced background levels of responses to other animals and failed to respond to either male or female urine at any time.

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CHEMOPERCEPTION OF MAJOR HISTOCOMPATIBILITY (MHC) TYPES AMONG MICE. K. Yamazaki, M. Yamaguchi, G. Beauchamp, J. Bard* and E. Boyse*. Monell Chemical Senses Center, Philadelphia, PA, 19104 and *Memorial Sloan-Kettering Cancer Center, 1275 York Avenue, New York, NY 10021.

The Major Histocompatibility Complex of genes (H-2 in the mouse; HLA in man) is of intense interest in many fields of biomedical research. This gene complex is the major determinant of compatability of grafted tissues and organs, and controls response to a legion of antigens. MHC genes determine susceptibility to several human diseases and quantitatively affect aspects of steroid metabolism whose connection with immunology is more distant. The considerable genetic variation of MHC genes accounts largely for what P. Medawar called "the uniqueness of the individual" in an immunological context. From such evidence as the ubiquity of MHC-equivalent loci among vertebrates, the only phylum in which adaptive immunity is highly developed, L. Thomas deduced that the origin of MHC mechanisms reaches far back into metazoan evolution, subserving purposes more general than latter-day immune chemorecognition.

Previous studies demonstrated that H-2 type influenced mate choice in mice. Generally, matings were more frequent between mice of different H-2 types. Assortative MHC-associated mating among mice may suggest a link between chemorecognition by lymphocytes and by olfactory neurons. Clearly, chemosensory communication influencing mating behavior should be a prime force in speciation and phylogeny. To elucidate MHC-associated sensory recognition, and to provide a basis for chemical analysis of MHC-associated sensory signals, we trained mice to identify arms of a Y maze scented by air currents drawn from congenic mice differing only in their MHC types. New data, to be presented at this meeting, show that urine is a potent source of MHC-associated odors that mice can recognize in the Y maze.