E-MAIL FROM PAKISTAN

By Brian Crowley

"Lahore", says my daughter Jane, is "the most foreign place I've ever visited". Donkeys, horses, camels, oxen, share the road with 3-wheeled, motorised rickshaws, buses, cars & mini buses. For every 2 minutes we re in Pakistan, a twenty minute story can be told.

We live on chicken curry, and spinach dhal with lovely hot naan bread cooked on the spot in the big tandoori ovens while you wait. We go to Gawl Mandi where the streets are cordoned off from the traffic and they specialise in fried fish. We sit at Siraj's and start with fresh Corn and Chicken Soup and watch huge hunks of fish, in batter being dropped into large oil-filled woks about a meter wide. Delicious! We finish with freshly squeezed pomegranate juice (no alcohol allowed in Pakistan). Galub Jamuns and sweet, sweet pancakes. Oink!

The food stalls are magnificent. Meat on offer is mostly chicken, but mutton and goat make casseroles that are spicy, wet, hot and full of flavour. Fresh fruit is everywhere with brightly coloured juicy mandarins piled high on carts, drawn by tiny donkeys. Yellow crispy guavas weigh down the local merchants on their circa 1930 bicycles. On the side of the main roads are "chi stops" where more carts are stacked with yummie merchandise. One has beautifully coloured tins of basic contents. I use my limited "Urdu" to buy one for 50 cents to find it contains a local type of Halvah, soft and full of walnuts, almonds and other delights. My son, Sean, gobbles it down in a flash. The "take away" containers are beautifully crafted and, to an outsider, more valuable than the contents. Take away curried mutton stew ($2.75) comes in a beautifully crafted clay pot glazed with coloured writing and designs. Now what to do with all those clay pots?

A veggie seller on his horse and cart "clippity clopping" through the early, cold and misty morning down our street. Whatever we buy his price is always 90 rupee (A$2.60). Whether it is huge amounts of produce or a couple of bags of fruit for the day he answers with a wry smile and says: "ninety rupeeeee".

Eve shops for bread in Lahore

Lahore is one of the most undeveloped cities I've seen. Its single modern, building, 11 stories high, goes unnoticed against the acres of British/Indian/Colonial architecture. But its real jewels are the Shahi Qala (The Royal Fort) begun in 900 AD and completed around 1566 AD, and the Badshi Mosque built by the Mughals in the 1600's. These gems are completely intact and take up huge tracts of land with not a tourist in sight (except for us). Also there is the "Old Walled City" which was built in the Mughal days surrounded by a 9 metre high brick wall with imposing structures at the 13 entrances to this part of the city. Here, you can still come across tiny shops where craftsmen can be seen turning out masterpieces in copper, brass, silver and musical instruments in traditional fashion.

Sadly we must leave without seeing the Shalimar Gardens and the Basant Festival where locals fly their kites in competitions to herald the coming of spring. It is said the children arm the kite strings with glass to cut the strings of the opponents. Last kite flying wins. That's life in Pakistan.

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ChemoSense

FOCUS ON INFINITY

To a modern-day project manager, *focus* generally means meeting an objective, on time, within the budget and avoiding distractions in the process.

Focus is a word (from Latin, meaning hearth) used mostly with reference to optics and vision. Can the metaphor of focus apply to the chemical senses, a field of inquiry which rivals astronomy for width and depth? Yes, provided our metaphorical lenses are infinitely wide and powerful.

In this issue of *ChemoSense*, Graham Bell takes a panoramic view of the subject of human olfactory experience and addresses a number of salient issues. Why are some odours so pleasant and some so obnoxious? Should odour pollution be taken more seriously? How important are environmental odours to our social interactions, productivity and well-being?

The 32 Abstracts of the Third Annual Meeting of **AACSS**, Australasia s ChemoSensory Association, great in intellectual diversity, are contained in this issue.

Amy Leung identifies a formidable barrier for breakfast cereal in Hong Kong. It heralds similar potential difficulties elsewhere in China.

Odour management for health, productivity and quality of life

by Graham A. Bell, Centre for ChemoSensory Research, UNSW
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Unless you were born anosmic, or lost your sense of smell early in life, you will have experienced the many delightful and sometimes utterly disgusting aspects of the sense of smell. Yet, some people have a high tolerance for living and working in the most repulsive odour environments. How they adapt to such environments and why others cannot or do not wish to, is a subject of growing community, commercial and industrial concern. Research can address these concerns and point the way to controlling odours. Among the expected outcomes are happy, healthy and more productive people.

What makes an odour repugnant?

Are we genetically predisposed to respond to certain odours positively or negatively, or do we acquire a learned attraction or aversion to them in infancy?

A baby is invariably excited by the smell of its mother's breast milk. The newborn will turn its head toward the smell and root around until it finds the nipple. This behaviour may be learned in the first day or two or even be established in utero (Bartoshuk and Beauchamp, 1994). By three years of age, however, an infant can have odour preferences and aversions that resemble those of adults (Schmidt and Beauchamp, 1988).

So, nasty smells become identified as such very early in life. But, if the process is not entirely innate, then repugnancy should be culture-dependent. Available evidence suggests that repugnant odours are common across cultures, for example, in Germany and Japan, people agree that malodours include burnt or rotting food, excrement, body odours and sweat (Schleidt et al., 1988).

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Centre for ChemoSensory Research
The University of New South Wales
ISSN 1442-9098

ODOUR MANAGEMENT

FOR HEALTH, PRODUCTIVITY AND QUALITY OF LIFE

Nevertheless, every culture is rich with characteristic fragrances, many of which are malodorous, that tell its stories, its past, present and the style of its people s lives, their dreams and ambitions. A culture has its characteristic background odours as well as its fashionable or contemporary odours.

The power of fragrance has been a feature of most religious practices since the dawn of history. Could it be possible that early in mankind's religious experiences he discovered psychotropic substances, perhaps steroids or pheromones, in burning various offerings to the gods, or spirits? Perhaps special smoky offerings evolved into a utilitarian form which we now know as the joss stick or the powdered resins and sawdust of modern incense. Why is religious ecstasy so commonly facilitated by fragrance? Have these rituals evolved from man's desire to rediscover the power of his vestigial mammalian olfactory signals? (Stoddart 1999). Or were ritual incenses, as used in Gothic Christian practice, a simple device to mask the stench of the congregation and decaying corpses in the crypt?

Overcoming repugnance of an odour can require a specific overriding idea, such as romantic yearning for a special place, as expressed in the Australian poem, "William Street" by Kenneth Slessor, which prefaces page 3.

Repugnance for the smell of some foods can be overcome with practice: kippers, liver, kidneys, tripe, gorgonzola, durian. For most people, however, these foods require a state of odour blindness, or an iron will, to place in the mouth and swallow.

Malodour has its pleasurable uses, particularly in sexual arousal. Napoleon's fascination for the body odours of a long-unwashed Josephine are legendary. But mostly, malodour disgusts, repels, and reduces people's perceived quality of life, as has been well argued recently by Van Toller (1999).

Malodour can also make people mentally dull. Rotton (1983) found that exposure to malodour decreases performance of complex tasks such as proof-reading. Even the mere suggestion of the presence of a malodour (a sham one) can decrease performance (Knasko and Gilbert, 1990). However, odours of many kinds, not necessarily unpleasant ones, can decrease (jasmine) or increase performance (lavender), as systematic studies have recently demonstrated (Degel and Koster, 1999). This suggests that there are functional component molecules in such odorant mixtures that have a performance effect independent of their hedonic quality.

The importance of context

Since people encounter odours in every aspect of their lives, they are generally prepared to put up with unpleasant odours in their appropriate context. Consideration of context is therefore crucial in assessing the hedonic value of odours, and the need to control them.

The smell of burning rubber, in the context of a motor race, brings happy excitement, even euphoria to the spectators, but that odour would be most unacceptable at a dinner party.

Evidence suggests that perceived quality and intensity of odour, are dependent upon the context in which they are presented and the degree of familiarity of the odour (Lawless et al., 1991, Song and Bell, 1998, Distel et al, 1999). These studies also showed that unfamiliar odours are invariably judged as less pleasant than familiar ones. So, if an odour is unusual or is encountered in an unfamiliar context, its perceived intensity and quality can be altered and its pleasantness reduced.

Effects of losing your sense of smell

Unless our olfactory anatomy and physiology is damaged, and we are rendered smell blind, or *anosmic* , we have to live with odour. Some people are born smell blind to several compounds or classes of compound (Amoore, 1977). It is estimated that about 50% of people are specifically anosmic to the sweaty, musky odour of the molecule called androstenone, also known as boar taint (Labows and Wysocki, 1984). These anosmias reinforce the argument that the ability to smell specific compounds must be determined by a specific gene or genes, and might be used to predict the number of receptor types in olfaction (Amoore, 1977).

Full or partial loss of olfaction as a result of head trauma, respiratory infection, nasal or sinus disease (see review by Smith, 1991) can produce unpleasant consequences for the sufferer, including inappropriate smell sensations, or "smell phantoms". Insufficient research has been conducted on the lifestyle consequences of sudden loss of smell. Complaints focus on loss of food appreciation, loss of the pleasure of cooking for themselves and others, safety issues arising from not being able to smell gases, smoke or toxicants, personal hygiene and loss of self confidence and esteem.

Loss of ability to smell is most common in the elderly, and is associated with general decline of functions and health that come with aging (Doty et al., 1984; Wysocki and Gilbert, 1989; Ship and Weiffenbach, 1993). Sufferers find food less palatable, dietary intake suffers, and injuries from burns, spills and food poisoning increase. The

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Smells rich and rasping, smoke and fat and fish
And puffs of paraffin that criimp the nose,
Or grease that blesses onions with a hiss;
You find it ugly, I find it lovely.

From the poem William Street by Kenneth Slessor (1901-1971)
(Kramer, 1985)

consequences of urinary incontinence may seem serious to the unaffected (osmic) carer or attendant, who receives the full olfactory "message", to which the elderly (anosmic) patient is oblivious. This can result in diminution of attention from the relatives and visitors of the elderly person who are repulsed by the malodorous environment of the unfortunate elderly person.

Serious consequences of unwanted odours

Peoples' behaviour toward each other is moderated by each other's odour. It is very difficult to be kindly disposed to someone who fills the air with an unpleasant odour. The work of Dr. Kathryn Hamlin, in Ethiopia, has shown that eliminating a chronic problem of urine odour in African women, by means of the repair of a fistula (small hole) in the bladder, rehabilitates a woman from being an unhappy social outcast to a fully functional, happy member of the community (Documentary "The Outcasts," BBC QED program shown on the Australian Broadcasting Corporation program "Compass" in May, 1998).

The power of an environmental odour can have serious consequences. Odours can trigger fears and invoke states of shock. They can exacerbate pre-existing medical conditions such as bronchial asthma (Shim and Williams, 1986). They can also signal an allergic reaction, even though odorant molecules are too small to directly cause the antibody, they can evoke an attack by association (Eriksson et al., 1987). In these cases, odour triggers can be fatal. People in this unfortunate position need to control their exposure to odours with utmost care.

Exposure to unwanted odours such as those caused by environmental and industrial pollution may also be very distressing and dangerous. A review by Shusterman (1992) dealt with the sources and definitions of environmental odour pollution. It concluded that the difficulties of measuring odour pollution objectively and linking it to the relatively consistent patterns of subjective symptoms reported by people who live near environmental odour sources, currently retard development of policy and regulation. Nevertheless, the review documents several acute and severe odour-related symptoms in people exposed to low concentrations of odorant: too low to be considered "toxicologically credible". These effects include innate odour aversions, innate pheromonal phenomena, odour-related exacerbation of underlying conditions, odour-related aversive conditioning, odour-related stress induced illness, mass psychogenic illness and recall bias.

Among the most dramatic and serious consequences of unwanted odour is the exacerbation of underlying conditions, such as:

- bronchial asthma, which can cause fatal breathing distress
- "morning sickness," in pregnant women, with its symptoms of dizziness and nausea, and debilitating stress
- psychosomatic disorders which cause distress and incapacitation, including acute elevated blood pressure and headaches (Shusterman, 1992).

Odour experienced in the environment may also trigger an epidemic of fainting, nausea, hyperventilation or panic attacks. This is called "mass psychogenic illness" (Shusterman, 1992). A variety of domestic and industrial odours are known to trigger these diverse symptoms: the aroma of coffee, the smell of fatty foods, the smell of cigars and cigarettes, perfumes, fragrance of flowers, cleaning products, paints, petroleum products, polyvinylchloride plastic, and odours from waste dumps.

There is no dispute that people suffer consistently from these symptoms and that their discomfort is triggered by odours. While medical intervention is essential in most cases, it would be wise also to control or eliminate the unwanted odours which have such serious consequences for the sufferer.

The signal value of odour

There is growing interest in identifying compounds which might act as human pheromones, but no such compound has yet been named, and doubt still remains as to whether humans possess sufficient structure to support a functioning vomeronasal organ (Abolmaali, et al., 2001). Nevertheless, chemical communication between humans is given credence by evidence that airborne androgenic steroids can entrain the oestrus cycle of groups of females (Preti et al., 1986).

Odours can signal danger, particularly from materials rotting, burning and leaking. Odours can also signal the genetic constitution of an individual (Ferstl at al., 1992) or that the person has a health problem. Illness can be manifested in the odours emanating from a patient: for example, ketone breath of the diabetic; fishy body odour in metabolic disorders (Leopold et al., 1990); and putrescent mouth odours in some dental conditions. As detection and identification methods for breath odours

grow, so the diagnosis of a number of serious and life-threatening diseases will be made earlier and treatment initiated and monitored more effectively (Phillips, 1992).

Awareness of the presence and effect of odour

Most environmental odours operate beneath the level of awareness. Nature plays tricks on us and keeps us ignorant of our smelly problems: by the process of sensory adaptation, whereby the sensation of the odour disappears (involving saturation and attenuation of olfactory receptor cells) they themselves can't smell the malodour. Stinky people can be blissfully unaware of their problem.

Sensory adaptation allows workers at sewerage and similar highly malodorous plants to tolerate the malodour of the work environment. Their clothes and even their blood streams become loaded with the odour and they need to take steps to clean up thoroughly before going home. Even then the odour seeps slowly from the pores in their skin, for hours after the exposure, with unpleasant effects for themselves and their families.

Young men and women become acutely aware of their own odours after puberty. Suddenly mouth fresheners, deodorants, chewing gum, peppermints, bath oils, scented soaps, potpourri, essential oils, oil burners, scented candles, scented stationery, incense, air fresheners, and designer perfumes loom large in the lifestyle of the teenager, around 14 years of age. This is a sub-cultural phenomenon, and a marketing bonanza, as the purveyors of the products well know.

The future

The olfactory system employs a number of mechanisms to receive odours and to reset itself. We need to understand how nature has solved similar odour management problems, such as by removing an odour with an enzyme or carrier protein (Bell, 1999). Furthermore, as we improve our methods of measuring smells, so we can invent ways to use, enhance or eliminate them. Smells can harm people, but so can toxicants which are odourless. We can expect to see, in future, "super-noses" - devices which behave with the efficiency of the nose but operate on volatiles beyond the range of human or dog noses. However the problems are solved, there are good prospects for cleaner environmental air, safer living and working spaces, and more pleasant human interactions.

ACKNOWLEDGEMENT
Research for this article was supported by Procter and Gamble, Australia Pty Ltd.

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Meet Monell ...

The world's first basic research institute dedicated exclusively to the study of taste, smell, and chemosensory irritation.

by Leslie J. Stein
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Outside, the first thing that strikes you is the statue: a golden nose and mouth, nine feet tall. Then, as you walk through the doors of the building in Philadelphia, you are greeted by a remarkable assortment of photos and figures. The images include a fluorescent photomicrograph of living human olfactory neurons, the smiling face of a baby happily eating his dinner, glistening spherical bubbles of carbonation, a series of smokestacks spewing out vast clouds of industrial discharge. Welcome to the Monell Chemical Senses Center.

When Monell was established in 1968, great strides were being made towards understanding the senses of vision and hearing, but little attention was paid to the "minor" senses, taste and smell. Recognizing the contribution and importance of these senses to development, food choice, emotion, communication and many other aspects of our lives, a group of individuals from diverse backgrounds, including academia, industry, government, and private foundations, joined together to provide the vision, organizational skills, and financial basis to create what is now regarded as the world's leading institution for fundamental chemosensory research. Originally based at the University of Pennsylvania, Monell now operates as an independent organization, but retains close working ties with the University, as well as with other medical and educational institutions.

The goal of the fifty or so scientists who make up the Center's staff is to conduct basic research on the mechanisms and functions of the chemical senses. Monell is by necessity a multidisciplinary institution. Chemical stimuli are transduced by biological structures into nerve impulses, and the information in the nerve impulses is transformed into sensations and perceptions that ultimately alter behavior. To unravel these complex, interwoven processes, scientists from a wide variety of backgrounds, including organic chemistry and biochemistry, molecular and cellular biology, immunology, genetics, physiology, psychology, and nutrition, are encouraged to collaborate. The Center has no formal departments or divisions: most of the research is interdisciplinary, involving internal interactions and an extensive network of colleagues from academic and corporate research facilities from throughout the world.

Although Monell is an academic institution, and its scientists determine their own research interests, industry has played a role at Monell from the beginning. Seeking to invest in the future, several companies agreed to contribute initial short-term funding when the Center was founded. Today, over 50 companies and manufacturers organizations provide financial support as part of the Center's Corporate Sponsorship program. Unlike government grants — which constitute Monell's major funding source — sponsorship funds are unrestricted, providing the flexibility that permits the Center to initiate new programs, hire new faculty, and provide support for beginning scientists. Companies that support Monell are involved in a diverse range of enterprises, ranging from foods and beverages to fragrances to personal care products, pharmaceuticals, industrial chemicals, pet care products and more. Individuals from these companies provide Monell scientists with insights into real-world problems, and contribute a different perspective from that typically seen in purely academic institutions.

By funding basic research at Monell, corporate sponsors are able to direct more of their own efforts towards applied research. In addition, sponsoring companies have exclusive consultation rights, with access to research scientists possessing a wide scope of knowledge concerning the mechanisms and functions of the chemical senses. Each year, Monell organizes a specialized research colloquium, drawing on both in-house and external experts to explore topics such as "Volatiles, Health and the Environment" or "Modifying the Chemical Senses." This year, the presentations will focus on "Development, Aging, and Regeneration." A more general meeting, spanning three days, brings sponsors up-to-date concerning Monell's latest research findings. Smaller roundtable discussions and one-on-one conversations allow sponsors to intensely explore specific problems or methodologies. As an example, Monell scientists may provide sponsors with suggestions on how to

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Breakfast in Hong Kong

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In cities such as Hong Kong, Taiwan and Singapore, where the eating habits are strongly influenced by Western culture, the range of food never seems to stop expanding. Seven of the top ten destinations for Australian processed food exports in 1997-98 were in the Asian region (AFFA, 1999). Although it is realised that Asian taste is becoming Westernised, it does not mean that the differences between cultures can be neglected.

A study of breakfast habits carried out recently in Hong Kong (Leung, 1999) found that most respondents consistently try new foods (at least occasionally).

A Slice of Life

Contrary to popular Western belief, that Chinese eat mostly congee (rice, corn and meat soup) for breakfast, it is sandwiches, toast or bread slices that are the most commonly consumed for breakfast in Hong Kong (Leung, 1999). Part of the reason for this is that bread is readily available and convenient for both home and restaurant use.

The range of bakery products is wide in Hong Kong. There are traditional bakeries making bread typically looser and softer in texture and slightly sweeter, than Australian bread. There are also modern bakeries producing everything from sweet buns, to Western-style French bread, to Japanese-style soft cake flavoured with green tea.

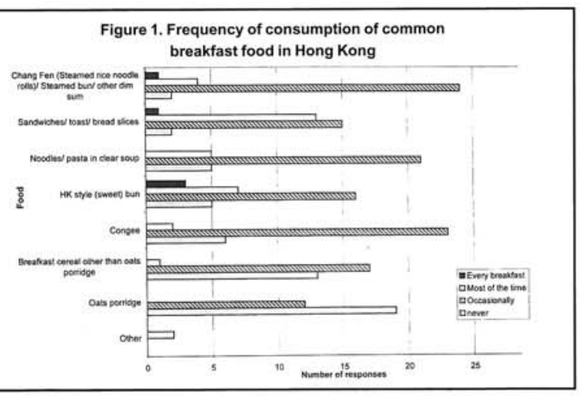
A peculiarly Hong Kong use of bread for breakfast is toast, spread with peanut butter, then topped with sweetened condensed milk.

Dim Sum for Some

Although England brought bacon and eggs to Hong Kong and these convey images of "wholesome countryside living" (Carter, 2000), dim sum still represents a full breakfast to most Hong Kong people. Traditional Cantonese food such as dim-sum, noodles and congee are still the popular, because they are tasty and filling **(Figure 1)**, however the social habit of meeting for breakfast is now restricted to the older generation or those with more time on their hands.

Dim sum is a name for a variety of rolls, dumplings and buns: steamed, fried or deep-fried (Beale 2000). They are served in restaurants and sold throughout the older, slowly disappearing residential areas, by hawkers. This manifestation of old Cantonese lifestyle is giving way to the frozen dim sum, heated by microwave for your convenience, at the modern supermarket or 24 hour store.

Figure 1. Frequency of consumption of common breakfast food in Hong Kong



Cha Chann Ting

Tea-cafes (called 'cha chann ting') represent another East-meets-West characteristic of Hong Kong (Cheung, 1998). They operate daily from early morning to midnight, in almost every neighborhood and commercial street. It combines a coffee shop, bakery, congee and noodle shop, soda-fountain and (Chinese) dessert parlour and general fast-food cafeteria. Cheap prices and having what you want, when you want it, helps sustain the popularity of the tea-cafe. For example, you will find oat porridge available in most tea-cafes, and a special Hong Kong invention: *Yin Yeung* —a mixture of milk, coffee and tea.

Flavour: the Cereal Killer

Breakfast cereal was introduced to Hong Kong a long time ago. Nevertheless, it remains unpopular. Breakfast cereals and porridge are regarded by Hong Kong consumers as most 'unusual for breakfast' (Leung, 1999). The people surveyed thought breakfast cereals were nutritious, but they don't like the flavour. Despite the emphasis in Chinese cuisine upon health of every food component, Hong Kong consumers are reluctant to trade-off flavour acceptability for nutritional quality when it comes to breakfast cereal.

Amy's Dad has breakfast in a Cha Chann Ting

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Meet Monell cont d

identify and overcome undesirable chemosensory characteristics associated with a product. These suggestions are directly derived from the scientists understanding of the basic mechanisms that underlie chemosensory detection and perception.

Monell is not a contract research laboratory and conducts no direct product research. Staff members chose their research projects based on their own interests and are deeply committed to the pursuit of fundamental knowledge. However, there are projects that have both basic and applied components, and the Center now has a substantial number of research agreements with sponsoring companies. Although these agreements are confidential while projects are underway, results must be submitted for publication upon completion of the project. Monell s scientists publish their findings in a wide variety of peer-reviewed journals, including widely-circulated ones such as *Nature*, *Science*, the *New England Journal of Medicine*, and the *American Journal of Physiology*. In addition, Monell publications appear in various specialized journals, including *Chemical Senses*, *Appetite*, *The Journal of Chemical Ecology*, *The Journal of Industrial Hygiene,* and *Behavior Genetics*. The Center also maintains a high visibility in trade journals, such as *Food Technology* and *Perfumer & Flavorist*.

Although Monell encourages a multidisciplinary approach, its research can be divided into six overlapping research programs:

- *The Program in Sensation and Perception* is at the forefront in developing and using accurate human sensory measures. The Program explores issues related to chemosensory perception throughout the lifespan, from prenatal to infancy to childhood to the aging; much of the research speaks directly to questions related to palatability and the development of food preferences.

- *The Program in Neuroscience and Molecular Biology* is a world leader in use of human sensory tissue to investigate the mechanisms of chemoreception. Work using molecular genetic techniques is helping to identify heritable influences on chemosensory detection and perception.

- *The Program in Environmental and Occupational Health* studies the response of humans to environmental odors and irritants, such as those emitted by industry and agriculture. Its scientists determine the effects of exposure to volatiles on the perception, cognition and physiological dimensions of the subject.

- *The Nutrition and Appetite Program* is a world leader in studying the physiology and biochemistry of appetite, as these relate to the chemical senses. Its scientists are clarifying the role that the chemical senses play in obesity, from both a food intake perspective and a physiological perspective. Their studies are focused to investigate the impact that the chemical senses have upon health status and quality of life.

- *The Program in Health and Well-Being* concentrates on the response of humans to tastes and odors from a clinical perspective. The Monell Center maintains an active and growing Chemosensory Clinical Research Center in collaboration with The Thomas Jefferson Hospital in Philadelphia. The Clinical Center continues to develop important databases on the incidence, epidemiology and etiology of loss, diminution or distortion of the chemical senses. While treatment options are limited at this time, the research component of the Program is exploring treatment procedures in animal models. Human body odors are another area of interest in this program, both as they pertain to disease and to quality of life issues.

- *The Program in Chemical Ecology and Communication* seeks ways of using chemicals to control certain animal pest species that threaten both agricultural and aquatic food crops. Experimental studies explore odor management and the production of odors by animals and humans for communication and reproductive purposes (e.g., pheromones).

Although the Monell Center is not a degree-granting institution, students and scientists interested in chemosensory research find Monell to be an outstanding resource for learning. Visiting scientists, some on leave from academic positions, and others sent by the Center's corporate sponsors, come to Monell to collaborate with the Center's faculty, learn new skills, or both. Monell's strong postdoctoral program attracts beginning scientists from a wide rang of disciplines; approximately 20 post-doctoral fellows, many of whom have no previous formal training in the chemical senses, are trained at the Center each year. Many of these scientists are hired by sponsoring companies after the completion of their training at Monell. Graduate and undergraduate students from nearby universities also participate in research training programs, and the Center's High School Student Research Apprentice Program, funded by grants from local foundations, brings at least 20 students, including many minority students, to Monell each summer.

The Monell Center is headed by Dr. Gary Beauchamp, who was appointed director in 1990 following the death of Monell's founder, Dr. Morley Kare. Dr. Beauchamp, like many of the staff and sponsors, has been at the Center for much of its existence. In addition, talented young scientists continue to join the Center's staff, bringing with them fresh ideas and novel insight into research questions. Monell continues to grow and much continues to change about the way science is done. What hasn't changed is the enthusiasm and commitment to basic scientific research evident throughout Monell.

For more information about Monell, please visit the Center s web site at www.monell.org.

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Third Annual Meeting of The Australasian Association for ChemoSensory Science

Held at Swinburne University of Technology, Hawthorn, Victoria, Australia, 30 November - 1 December, 2000

Vol. 3 No. 2 March 2001

1. Odour Mixture Perception: From Molecules to Memory

A. Jinks, D.G. Laing, & I. Hutchinson

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Psychophysical techniques using human subjects have discovered certain consistent properties of simple [two component] odour mixtures, namely the ability to identify each odorant, the perceived separation of odorants in time [temporal processing] and the suppression of odorant intensities in comparison to their unmixed intensities. However, as odour mixtures increase in size the identification of component odorants becomes more difficult, which may explain the concurrent attenuation in temporal processing found for these mixtures and the inability of subjects to judge individual component intensities. In order to understand such features of complex mixtures, an appreciation of both physiological and cognitive factors is required. For example, physiological events such as competition for peripheral ligand-binding sites in the olfactory epithelium and intrabulbar inhibitory activity are believed to consolidate odour information in the mixture, hence remove the ability of subjects to identify, and rate the strength of, component odorants. Cognitive factors including arousal, attention, learning and memory may also limit the amount of information that can be extracted from the odorous stimulus. The challenge is therefore to satisfactorily combine both physiological and cognitive factors into a concise working model of odour mixture perception, whilst taking into account several confounding issues affecting the interpretation of experimental results involving these mixtures.

2. The Influence of Physico-Chemical Factors on the Order of Perception of Odours Perceived Retronasally — A Time-intensity Study

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When a food or beverage is consumed, a wide range of odorants and tastants are often released into the mouth. Both taste and odor research indicate that tastants and odorants, perceived via the mouth and nose, respectively, are processed and perceived temporally, and that the smaller the time interval between the release of components the more difficult discrimination and identification of individual components becomes. Accordingly, it is likely that many components released from a food may not be perceived because of limitations related to temporal processing and discrimination. To date, no studies of the temporal processing of odorants perceived via retronasal [the mouth] sampling have been reported. Processing via this mode of transport could potentially be strongly influenced by the differential adsorption of odorants by the mucous in the pharynx which could act like a chromatographic column and adsorb and desorb odorants on the basis of their volatility, molecular weight or water solubility. Accordingly, the perception of 4 pairs of aliphatic odorants, balanced for perceived intensity [retronasal perception] and differing in volatility and water solubility, and having no taste, was determined using a time-intensity paradigm. The results available from 2 pairs indicate that the more volatile component requires a shorter time to reach maximum intensity and is perceived for less time. If these findings are replicated with the other two pairs [to be presented at the Conference], they will provide a new insight to the mechanisms underlying the perception of chemosensory stimuli released in the mouth, the most common location when eating and drinking.

3. Properties of Mammalian Olfactory CNG and IP_3-Gated Ion Channels Involved in Olfactory Transduction

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Cyclic nucleotide-gated [CNG] ion channels are known to play critical roles in olfactory transduction in olfactory receptor neurons [ORNs] and IP_3-gated channels have been shown to be important in non-mammalian ORNs. In experiments on dissociated adult rat olfactory receptor neurons [ORNs], we have shown that, although there are IP_3-gated channels present in these ORNs, the IP_3-gated channels are at a much lower density than the CNG channels. This result is consistent with the suggestion, based on other evidence, that the cAMP pathway is more dominant than the IP_3 one for olfactory transduction in mammalian ORNs. We have also shown that there is a much higher density of second messenger-gated ion channels in the membrane of the dendritic knob than in that of the cell soma.

In addition, we have compared the properties of recombinant alpha homomeric olfactory [rOCNC1] channels in HEK293 cells with those of native CNG channels, which have both alpha and beta subunits. In particular, we have measured their selectivity to both alkali and organic cations, together with some of their other permeation properties. These results have also indicated that the recombinant channels are a good model for investigating the permeation and selectivity properties of CNG channels.

[1] Supported by the Australian Research Council and the CRC for International Food Manufacture and Packaging Science.

4. Generation and Characterisation of Olfactory Progenitor Neurospheres from Neonatal Rat Neuroepithelium

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The peripheral olfactory system is unique in maintaining a neuronal progenitor population which continues to proliferate and generate new neurones in the adult. This progenitor is believed to reside in the basal cell population and it is likely this neural stem cell differs significantly from those found in the brain and spinal cord. Neonatal rat pups were decapitated and olfactory turbinate tissue cultured using selective filtration and a modification of a primary culture method we described recently (Cunningham et al, 1999). After 48 hours *in vitro* we generated neurospheres: large, multicellular, clusters of cells. Using fluorescent immunocytochemistry and laser scanning confocal microscopy we have been able to look inside the neurospheres and characterise their morphology and immunoreactivity. BrdU incorporation confirmed that cells within the spheres were proliferating and they also expressed the intermediate filament protein nestin. The neurospheres labelled with GBC-1 an antibody recognising globose basal cells *in vivo*. In contrast, the cells in the neurospheres were negative for NST expression, a neuronal marker. It was striking, however, that there was an association of tiny, immature NST-positive neurones with the periphery of the neurospheres and double immunostaining with S100 confirmed neurones migrated away from spheres in close association with an olfactory ensheathing cell. Current studies are aimed at understanding the trophic factor requirements and lineage commitment of this unique progenitor cell.

[1] Supported by the Garnett Passe & Rodney Williams Memorial Foundation and the NH&MRC of Australia

5. Taste Interactions of Fats and Oils in Mixtures

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Many sensory studies address the textural impact of fats and oils in foods, while relatively few investigate the possible gustatory interaction fats and oils may have with food ingredients. One reason for this is the difficulty in disassociating texture from taste when fats and oils are presented to human subjects who must inevitably "feel" the fat/oil stimulus on their tongue in order to "taste" it. Furthermore, conventionally, fats and oils were not believed to stimulate the gustatory sense at all. Only recently has evidence been accumulating which indicate otherwise. Gilbertson et al. (1999) demonstrated that isolated rat taste cells respond to cis-polyunsaturated fatty acids via inhibition of Kdr channels, akin to the mechanism involved in the detection of sweet, bitter or sour compounds (Kinnamon, 1992). Mattes (1996) found that oral fat/oil exposure alone [without ingestion] altered postprandial lipid metabolism in humans, thus suggesting a chemosensory signalling mechanism for lipids in the oral cavity. Whether human psychophysical studies also support a gustatory role for fats and oils was investigated in the current study. Since humans could not reliably measure the intensity of fat/oil 'taste', it was necessary to determine whether fats/oils influenced other taste qualities in a binary mixture context. A series of experiments were set up, consisting of binary mixtures that used oils in emulsion with tastant solutions. These were presented to the same panel of trained assessors. Results showed that while the presence of oil in emulsion had no significant interactions with any of the four basic tastes - salty, sour, sweet and bitter, an interaction between oil and MSG mixtures was apparent over a range of MSG concentrations and oil contents. Both ANOVA and paired comparison results indicated that the presence of oil enhanced the savoury [umami] taste of MSG solutions. Furthermore, in a ternary mixture of sucrose, MSG and oil, savoury taste intensity increased with the level of oil in emulsion while sweetness intensity did not.

6. Psychophysical Properties of Mechanical Oral Irritation: A Kiwifruit Model

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The basis of the mechanical oral irritation caused by free crystalline calcium oxalate (raphides) in kiwifruit was studied in two experiments using a model system. In the first experiment the location of irritation sensations and perceived intensity of the irritation caused by suspensions of raphides were rated. Irritation sensations in the model system were characterised. Burning, stinging and numbness were found to increase significantly with increasing concentrations of raphides. Irritation sensations showed variation in their location. Burning occurred principally in the throat; stinging on the tongue and in the throat and numbness on the tongue. In the second experiment sugars (fructose, sucrose, glucose and inositol), acids (citric, malic and quinic) and enzyme (actinidin) were added to the model to examine interactions between these chemical stimuli and the mechanical action of the raphides. Sweetness, acidity and irritation intensities were assessed.

7. Taste-Pore Density on the Tip of the Tongue - A Developmental Study

I. Hutchinson, C. Segovia, D.G. Laing & A. Jinks

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Eight-year-old children are less sensitive than adults to sucrose and other tastants when a whole-mouth testing procedure is used [1]. It is possible that the taste-bud densities of adults and young children differ and that this is the basis of the differences in sensitivity. The aim of this study is to compare the density of taste-pores on the anterior region of the tongue in adults and young males using a technique similar to that described by Miller and Reedy [2] which uses videomicroscopy to measure taste-pore density. Twenty young adult males and twenty 8-9 year old males were studied. Two small [9mm^2] regions near the tip of the tongue were stained with methylene blue which has been shown to stain the taste-pores. Videomicroscopy at high magnification was then used to examine and record all the fungiform papillae and taste-pores in each small region. The same small regions were studied a second time on a different day. Video images were captured and analysed using NIH 'Image' software. Children had a greater density of taste-pores on the tip of the tongue, however the number of taste-pores per papilla were similar in adults and children. The density of fungiform papillae in the two regions studied was greater in children than in adults and the papillae in children were smaller in diameter and more regularly shaped than those of adults. In view of previous findings [3] that the taste-sensitive area of the anterior tongue in 8 year-olds and adults is similar in size, it is likely that the greater sensitivity of small regions of children's tongues is due to a greater density of taste-buds. Children's higher thresholds to whole mouth stimulation may be due to a reduced capacity to assimilate the taste input from the whole mouth.

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8. Genetic Sensitivity to 6-n-Propylthiouracil Predicts Acceptance of Bitter-tasting Vegetables in 3-6 Year-Old Children

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Understanding what motivates the preference for and selection of foods has important health implications.Research suggests that many phytochemicals, present in green-leafy vegetables, contain important anti-carcinogenic properties which inhibit cancerous cell growth. Due to the bitter taste of phytochemical compounds foods containing these are often not well accepted, particularly by children. A relationship between taste sensitivity and taste preferences has been well established in adults, however, few have investigated this relationship in children. This study looked to investigate the degree to which taste preferences are mediated by genetic sensitivity to the chemical 6-n-propythiouracil (PROP). It was hypothesised that those children more sensitive to the bitter taste of PROP would dislike bitter- and strong-tasting foods more than less sensitive children. Forty-two children aged from three to six years participated in this study. Two independent measures of taste sensitivity and three independent measures of taste preference were employed. Results suggested a significant correlation between both measures of taste sensitivity and hedonic preferences for raw spinach as assessed on two taste preference tasks. While nutritionist advocate the consumption of spinach, the results of this study suggest that the early acceptance of this bitter-tasting vegetable may be genetically-mediated to some extent. Furthermore, the results of this study suggest that young children may partake in direct investigation of taste and children as young as three years of age may reliably comply with taste procedures and accurately communicate taste perceptions and preferences under study conditions.

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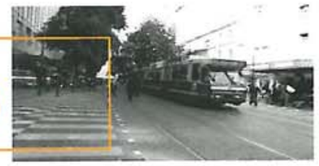

9. Analysis of Taste Mixtures and Taste-Odour Mixtures: Difficult Tasks

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Studies over the past decade indicate that it is very difficult for humans to identify more than 3 components in a mixture of up to 8 odorants [1, 2]. This limit appears to be independent of the task, type of odorants and complexity of individual odorants. Recently Jinks & Laing [3] suggested that in addition to limitations imposed by the system used by the sense to code odorants, that olfactory working memory may be the ultimate limiting factor. The present two experiments investigated whether there is a similar limitation in the analysis of taste mixtures and whether the parallel processing of the components of taste-odour mixtures by the gustatory and olfactory systems increases the number of components identified. Also, separate processing in working and long term memory could improve identification. The results indicate that a similar limit of up to 3 components in taste mixtures and in taste-odour mixtures exists. This suggests that long term memory, the most likeliest point of competition for information about identity of both odours and tastes, has insufficient capacity to cope with more than 3 chemosensory components in the short time period information about identity is passed on from the periphery during a drinking episode.

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10. Cognitive Influences on the Interactions of Odours and Tastes in Mixtures

J. Prescott, J. Francis & V. Johnstone

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When sweet smelling odours are experienced with a sweet tastant in solution, the mixture is often given a higher sweetness rating than the tastant alone. Such enhancement appears to be sensitive to whether an odour/taste combination is treated analytically as a set of discrete qualities, or synthetically as a flavour perception. The present research attempted to determine if these different perceptual approaches would influence the extent to which an odour would take on taste characteristics during co-exposure with sucrose, and its subsequent ability to enhance taste intensity. In Experiment 1, subjects received multiple exposures to mixtures of sucrose with four odours varying in initial familiarity and smelled sweetness or, as a control, the odours and sucrose solutions separately. Two groups that received mixtures made intensity ratings that promoted either synthesis or analysis of the individual elements in the mixtures. Adopting a synthetic approach selectively increased odour sweetness for the low familiarity odours. Changes in odour-induced sweetness enhancement also occurred following exposure, but independent of group. This was explained as due to both the ineffectiveness of the analytical strategy, as well incidental associative learning in the group that received the odours and tastes separately. Using an improved analytical procedures, Experiment 2 found that sweetness enhancement was produced by co-exposure with sucrose, but only for the group adopting a synthetic approach. Unexpectedly, the odours became sweeter irrespective of group and, in addition, the synthetic group showed sweetness enhancement with a non-exposed control odour. Both of these effects could be accounted for if the single co-exposure with sucrose that all odours received in the pre-test was able to produce sweeter odours. A third experiment confirmed this prediction. Thus, while even a single co-exposure with sucrose is sufficient to produce a sweeter odour, the adoption of a synthetic perceptual strategy during the co-exposure is necessary to produce an odour that will enhance sweetness. These data are consistent with associative leaning accounts of how odours take on taste qualities and, also support the notion that these effects reflect the central integration of odours and tastes into a functional flavor system in which the separate components become dimensions of a single percept.

11. Learning to Dislike an Odour Without Knowing Why

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The hedonic properties of odours — the degree to which they are liked or disliked — is much influenced by past associations. We report here initial results from a new experimental procedure designed to change subjects' hedonic ratings for odours and to allow us to examine the relative role of explicit and implicit ('without awareness') memory processes. Subjects were given the task of learning to associate each of 4 odours with a different picture. Two of these pictures had been previously rated as very unpleasant, while two were neutral. Different groups of subjects were given either 4, 8 or 12 pairings of each odour-picture combination. Memory for an odour-picture pairing was assessed both *explicitly* - in a recognition test requiring a subject to choose from the 4 alternatives the picture that had accompanied a given odour — and *implicitly* — by obtaining ratings of the properties of each odour. Recognition performance was poor, even in the 12-pairings group. On the other hand odours paired with the unpleasant pictures were rated as less pleasant, while these ratings did not change for odours paired with neutral pictures. This evaluative conditioning effect was no greater after 12 than after 4 pairings.

12. Wine-Tasting Expertise: Evidence for a New Approach

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Wine experts consistently show greater ability both to discriminate between and to accurately describe wine samples. The present study is concerned with the basis of such ability, whether sensory or based on higher-order processes. Two experiments were performed that investigated whether cognitive processing plays a role in wine expertise. Experiment 1 compared the memory of experts and novices for both varietal and random wine descriptions. The experts remembered more than novices, but only for the varietal and not the random descriptions. Experiment 2 evaluated the effects of various interference tasks on expert matching—to-sample [short-term recognition memory]. The results suggest that long-term memory structures are involved in expert performance. Both experiments produced outcomes consistent with the hypothesis that wine expertise, like other areas of expertise such as chess and bridge, is largely based on explicit knowledge about wine rather than on superior sensory ability.

13. Beer Sensory Qualities and Taster's Perceptions - An Electrophysiological, Sensory and Psychophysiological Study Comparing Expert and Consumer Tasting Panels

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Beer consumption to a large extent is dictated by the consumer s perception of the product. Consumer behaviour is influenced by product marketing activities, advertising penetration, package design, and product quality perceived. To the latter point, matching product sensory and tasting quality to consumer perception and expectation needs to go beyond the scientific approach that brewers normally take in designing the product. Research is needed which investigates the effect of consumer perception, expectation and behaviour on beer sensation and tasting quality. As a first step in this direction, a preliminary study has been conducted to investigate the correlation between general consumer and expert tasting panel responses to beer flavours using tastings, psychophysiological and electrophysiological measures. A panel of industry expert tasters and a panel of general beer consumers were established and profiled using subjective psychophysiological techniques. Both subject groups then participated in tasting sessions, making comparison of eight commercially available beers and rating the beers for attributes as found on the beer flavour wheel [1]. Members of each panel then participated in electroencephalo-graphic [EEG] recording sessions, during which beer volatiles were delivered using the continuous respiration olfactometer [CRO] developed at Swinburne University of Technology [2]. The recorded EEG was then analysed to investigate differences in brain electrical activity in response to beer odours cf air, and for differences between the responses to two different beers. Comparison of the psychophysiological and electrophysio-logical results for the consumer and expert panels will be reported.

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14. An Increasing Role for Sensory Research in Strategic Decision-making in the Food Industry

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The work of the applied sensory scientist now makes a generally well-understood and appreciated contribution to the product development and quality assurance functions in food manufacturing companies. It is also making gains in the companies' marketing departments, as it becomes clear that the product's market position can be better understood if the relative strengths and weaknesses of the products concerned can be identified and quantified. Sensory attribute data is being treated by an increasingly sophisticated arsenal of statistical and graphical procedures, to reveal, not only the sensory and non-sensory drivers of acceptance, but the segmentation of the consumer population into types of consumer about whom certain beliefs, attitudes and preferences can be expected. The data can highlight the need for and nature of entirely new product concepts. The data from applied sensory science can now inform a number of crucial business decisions for the company: raw material inputs, production processes, product formulations, packaging design, portion sizes, promotional ideas based on perceived consumer benefits, the market segment to be targeted and the competitive price. The sensory scientist can now make a significant impression, if allowed, on the executive decision-makers of a food company as they steer their companies to higher profits and lower costs against difficult odds. This paper will present some case studies to illustrate the points made above.

15. Convergence Without Topography in the Olfactory System of Gli3-deficient Mice

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The olfactory sensory neurons which reside in the epithelium lining the nasal cavity each express one out of a possible thousand odorant receptors. Sensory neurons expressing specific odorant receptors typically project their axons to at least one topographically-fixed glomerular target in each olfactory bulb. Therefore, the bulb provides a spatial map whereby the quality of an olfactory stimulus is encoded by a distinct spatial pattern of activity defined by the specific combination of glomeruli activated by a given odorant. We are interested in the cellular and molecular cues involved in guiding these axons to their precise glomerular targets. Although we know that the odorant receptors themselves are involved, the role of the target olfactory bulb cells in providing cues for the guidance and mapping of these axons is unclear. We have investigated the role of olfactory bulb neurons in the targeting of axons in Gli3 deficient mice expressing LacZ under the control of the P2 odorant receptor gene. In Gli3 deficient mice olfactory bulbs fail to develop and instead primary olfactory axons form a fibrocellular mass lacking laminar organization. In the absence of normal postsynaptic targets, P2 axons continued to sort out and specifically converge onto discrete loci in the fibrocellular mass. Targeting of axons to loci was also observed for a larger subpopulation of olfactory axons expressing cell surface carbohydrates recognised by the plant lectin *Dolichos biflorus* agglutinin. In conclusion, although the precise topography of the olfactory spatial map appears to be dependent on cues derived from the olfactory bulb, olfactory axon subsets can sort out and converge in the absence of their normal synaptic partners.

16. How is the Topographical Map in the Olfactory System Constructed?

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Primary sensory olfactory neurons, located in the neuroepithelium lining the nasal cavity, project a single axon to innervate the olfactory bulb in the brain. Individual neurons express only one of a possible thousand odorant receptor genes and neurons expressing the same odorant receptor, target stereotypical glomeruli within the olfactory bulb. Odorant receptor expression plays a major role in the final targeting of olfactory axons within the glomerular layer of the olfactory bulb. The precise cues which mediate selective axon fasciculation and sorting out within the olfactory nerve, however, are as yet to be defined. We have used monoclonal antibodies LA4 and KH10, which recognise distinct a-galactose extended lactoseries carbohydrate epitopes[1], to define a subpopulation of primary olfactory neurons in the rat. Both antibodies specifically labelled the perikarya and axons of distinct subpopulations of olfactory neurons from embryonic day 17 to adulthood. Positively labelled axons terminate in discrete glomeruli in the olfactory bulb. Strong expression of both carbohydrate antigens is also seen on sensory neurons in the vomeronasal organ and their axons in the accessory olfactory bulb. In the late embryonic developmental period, as olfactory glomeruli first appear, low levels of expression were observed on olfactory neurons widely scattered throughout the olfactory neuroepithelium lining the nasal cavity and on their axons in the nerve fibre layer of the olfactory bulb. The number of positive neurons increases during the early postnatal period as olfactory glomeruli become more distinct and increase in size and number. Axons expressing these carbohydrate antigens self-fasiculate and form distinct bundles in the nerve fibre layer, terminating in clearly distinguishable glomeruli. In the postnatal animal axons positive for the KH10 antigen projected predominately to glomeruli in the ventromedial regions of the bulb, whereas axons positive for the LA4 antigen exhibited a wider distribution pattern. At all ages studied the KH10 antibody recognised neurons restricted to a smaller subpopulation than the LA4 antibody. Western blot analysis confirmed that the lactoseries carbohydrates are present on N-CAM , increasing the repertoire of N-CAM glycoforms present in the olfactory system. The spatiotemporal expression patterns of these unique N-CAM glycoforms suggest a role in axonal guidance and patterning, particularly in the nerve fibre layer of the olfactory bulb.

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17. Discriminability of Fat Content as a Function of Prop Sensitivity

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Variability in the degree to which individuals perceive the compound 6-*n*-propylthiouracil [PROP] to be bitter have also been found to be

Photos: Caroline Owen

perceive the compound 6-*n*-propylthiouracil [PROP] to be bitter have also been found to be associated with differences in the perception of oral sensations other than tastes. Higher ratings of PROP bitterness are associated with increased intensity of oral pungency [1], increased creaminess in foods [2] and greater tactile sensations produced by oils and fats [3]. A number of different sensory properties contribute to perceptions of creaminess in foods, including odour, and mouthfeel characteristics such as viscosity and fat content. Tactile sensations produced by the relative density of fat globules contribute to creaminess perception independently of viscosity [4]. The present study investigated whether differential sensitivity to variations in fat content was the basis for differences in creaminess perception by different PROP taster groups. Subjects were classified as non-tasters, medium-tasters and super-tasters based on their ratings of the intensity of a 0.032 M PROP solution using the labelled magnitude scale [5]. Subjects undertook a signal detection discrimination task in which samples of milk containing 1.15, 1.9, 2.65 and 3.4% fat were compared with a reference sample containing 0.4% fat. All samples had approximately equivalent viscosity. Olfactory and visual differences between samples were eliminated by the use of nose clips and red light. Overall, discriminability increased with increasing fat levels in the samples. Particularly at higher fat levels, supertasters showed increased *d'* values relative to medium- and non-tasters. These data suggest that differences in ratings of creaminess as a function of PROP taster group are mediated by fat content. Since sensitivity to PROP is positively correlated with the density of fungiform papillae, and consequently with greater numbers of lingual nerve fibres, differences in fat discriminability may to be due to variations in the density of oral mechanoreceptors between the taster groups.

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18. Misidentification of Odours: Perceptual Bias and Semantic Memory in Expert and Novice Wine Judges

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Recent reports have provided evidence that much of the taste and smell of a wine is "not in the bottle, but is in our mind" [Brochet, 1999]. The present study investigates cognitive errors associated with olfactory-guided judgments as a function of domain-specific expertise. Despite similar olfactory sensitivities, 10 expert and 10 novice wine judges are predicted to differ, qualitatively and quantitatively, in terms of their erroneous judgments of wine-relevant, olfactory stimuli. Expertise is defined in terms of a wine judge's verbal [semantic] and olfactory experience with wine-relevant stimuli [Melcher & Schooler, 1996]. Twenty odorants, selected from *Le nez du vin* [Lenoir, 1995], are sampled orthonasally in odour-identification and odour-recognition tasks. In a subsequent discrimination task, experts and novices discriminate experimenter-specified odours in 4 model wines. Two of the four wines are identical in odour but differ on the basis of colour, where the colour manipulation simulates typical age-related change [e.g., development of terpene structures] or oenological-processing change [e.g., oaking]. Expert wine judges are predicted to have a higher probability of making judgment errors based on perceptual bias than novices [Cain & Potts, 1996], while novice judges are expected to have greater difficulty finding verbal labels for the odourants. Results will be interpreted within an associative memory framework where previously learned odour associations [e.g., colour of a wine and its association with particular odours] are predicted to influence judgment behaviour. In terms of meta-cognition, novice judges are expected to be aware when their odour-guided judgments are erroneous, resulting from gaps in their semantic memory. However, experts may be particularly confident that their erroneous judgments are correct [Cain & Potts, 1996], suggesting that vulnerability to errors of perceptual bias is a more insidious and potentially serious problem in wine judgments.

19. Investigation of Changes in Brain Electrical Activity Associated with Preference Responses to Odours

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Traditionally, research investigating preference responses to odours is qualitative, based on subjective reports and dependent on the subject's conscious detection of the odour stimulus. Previous research revealed changes in brain electrical activity associated with physiological responses to odours which were subjectively not detected [1]. Preliminary studies with different odours suggested changes in responses between odours and associated with reported preference for the odours [2], supporting previous reports of changes in regional activation related to hedonic responses [3, 4]. The current research was designed to further investigate these differences in responses. Subjective responses were correlated with objective physiological responses to investigate differences in perceptual responses to low concentration odours delivered during natural respiration. Eight subjects [balanced for gender, age, smoking status, handedness and olfactory ability] participated in repeated recordings of brain activity responses to d-limonene [citrus smell] and hexanoic acid [sweaty, cheese, sour smell]. Brain electrical activity was recorded with a 64-channel EGI system [saline electrodes] during delivery of air or odour. Stimulus delivery was synchronised with inspiration using a continuous respiration olfactometer [3], and presented at a ratio of three air to each odour in a pseudo-random order for five minutes recording periods. Subjective responses to the odour stimulus were assessed pre-recording. Subsequently, subjects indicated if they perceived an odour during the recording and completed preference response ratings of the odour. Subjects were placed in like and dislike groups based on their pre-recording preference responses to the odour stimulus. Neurophysiological responses to the test odour were examined and correlated with these preference groups. The brain activity responses of the odour differed in comparison to air. These responses were analysed using traditional EEG techniques to determine the relationship of the brain activity to the reported preferences. The power spectrum analysis for the like and dislike groups reflected differences in electrophysiological activation associated with preference responses, suggesting that odour preference may be reflected, in part, by these differences in the power spectrum in response to low concentrations of the odour. This analysis demonstrated a method of utilising different techniques to better quantify the neurophysiological effects of odour inhaled during natural respiration.

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20. Using Conjoint Analysis (Ideamap™) to Optimise School Lunches

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This study aimed to define what foods school-going consumers want and how these might be provided in a healthy form, which also meets the concerns of the parent, provider/carer of the children. Children aged 8 to 11 years, and parents of children of similar age, were chosen as subjects. An innovative computer-administrated research tool, Moskowitz's IdeaMap™ was used to define and then to optimize school lunch concepts that satisfy both parents and children s needs and wants. Preliminary studies of the subjects were carried out in two parts beforehand. Parents were interrogated by questionnaire and Focus group discussions were carried out with children. The elements for IdeaMap™ were generated from these preliminary findings. 100 sets of elements that comprised the concept were assessed by a panel of 26 children and 26 parents and rated on a scale of attractiveness with IdeaMap™ with the result that 80 elements were given an individual element score by means of the conjoint analysis routine provided by IdeaMap™. From the focus groups it was found that children's ideal lunch descriptions consisted of foods in the balanced form of main dish, side/treat and drink. Children were aware of the importance of nutrients and expressed liking of some fruits and vegetables. Packaging of the products also affected the expressed acceptability of the food product to the children in the focus groups. The optimum concept that satisfied both children and parents was "oven baked savory chicken spaghetti with cheese on top, fresh apple and non-fizzy drink. Label: high in calcium. Warmth: warm".This study demonstrated the power of conjoint analysis in arriving at numerical values for individual elements of a concept which are, by their nature, never assessed outside the context of other elements. The main finding of the study demonstrates the need to consider both the child s needs and wants (the food consumer) and those of the parent (the food producer).

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Vol. 3 No. 2 March 2001

21. Olfaction and Vision: Do Vision-impaired People Perceive Smells Differently?

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Research into sensory modalities of the vision impaired has predominantly focused on auditory abilities, particularly sound localisation, with the vision impaired producing a heightened performance on such tasks compared to the non-vision impaired. However, only a few studies have investigated the olfactory performance of the vision impaired, with conflicting findings. Methodological issues may have contributed to the differences in reported results, such as the use of squeeze bottles for odour presentation which produce tactile sensations as a result of air being squeezed from the bottle. The current study attempted to overcome delivery limitations by employing a more reliable test of olfactory performance, the Reichstifte *Sniffin' Sticks* Olfactory Test. This study examined whether individuals with vision impairment would demonstrate a heightened sensitivity in olfactory performance compared to normally sighted controls. Twenty participants, ten vision impaired and ten controls (age, sex and handedness matched) completed tests of odour threshold, discrimination and identification. The results indicated no significant differences in odour threshold or discrimination between the vision impaired and the non-vision impaired. Significant differences were found in the test of odour identification, with the non-vision impaired correctly identifying more odours than the vision impaired. When the results for threshold, discrimination and identification were combined to produce the overall olfactory performance score, the non-vision impaired outperformed the vision impaired. It was concluded that individuals with vision impairment do not demonstrate heightened olfactory performance.

22. Effects of Colour and Texture on The Perception of Flavour in Prepared Foods: A Data Mining Study

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Flavour is usually considered to be an integration of olfactory and gustatory information. However, there is sufficient evidence in the literature to show that perceived flavour can be modified by visual and textural sensory contributions to a food or beverage. These previous studies have mostly used experimental model foods. Will flavour of complex "real" foods also be affected by colour and texture perception? To explore this question it was necessary to forego the traditional experimental design and instead employ a post-hoc "data mining" approach. Data was available from a number of food assessments where the same protocol had been carried out: the same attribute judgements had been made in every case, using the same scaling method. This study used the inter-correlations of these data for visual, textural, smell, taste and flavour attributes from approximately 20 different prepared foods, as judged by groups of 35 or more consumers. The results showed that, in general sensory perceptions were often determined by the interaction of other two or more sensory attributes of a food. The effect of colour and texture on the perception of flavour was tested a parametric or non-parametric analysis depending on the distribution of the data. It was found that when colour is correlated with aroma, taste or flavour, individually, there is no significance difference between direction and degree of relationship across products. The same cannot be said about texture: texture interacted with flavour and with aroma and taste, in a product-dependent way, and with greater force. In the relationship between flavour and overall liking of a food, the role of appearance and colour liking was demonstrated with the use of cluster analysis.

23. Korean Consumer Habits and Sensory Preferences of Importance to Prospective Food Exporters

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Analysis of the demand potential of a foreign market based on the status of its economy is only the initial step when deciding whether to export to that country or not. The Republic of Korea has already been established as a key export potential among the rapidly recovering Asian Tiger countries. A further and important step that should be taken by those wanting to export to Korea is to examine, study and understand the Korean taste palate, their habits and other cultural factors that shape their preferences and habits regarding food. The first part of this study involved surveying a sample of Korean consumers. The questionnaire consisted of questions regarding the respondent's demographic profile, food-purchasing habits, taste preferences and also attitudes and opinions towards prevailing issues in the food industry such GMO content in food and product labelling. The general conclusion generated from these data is that Korean consumers have a high preference for convenience and 'luxury' food items (such as meat) although they remain price sensitive. Exporters should also contemplate targeting mid 20s to mid 30s age group because they are economically independent and have a higher propensity to try unfamiliar, foreign products compared to the older and younger age group. Other focus should be placed on the general female population especially Korean housewives since they appear to be the dominant decision-makers of food purchase among Korean households. The second part of the study was to conduct a series of interview with experts from specific areas in Korea, being food research and development, advertising and promotion, food retail, nutrition, and government advisory agencies. Korean consumer price sensitivity was reinforced in this part of the study as well as other key findings include existing nutritional inadequacies in the population which Australian food exporters may be able to capitalise on in terms of product design and product promotion mix. Qualitative on-site observations on some of the aspects of Korean food culture, consumer behaviour and the commercial environment were also carried out for the last part of the research. 'Fusion' and 'Functional Foods' restaurants were identified some of the emerging food trends in Korea. Signs indicative of increasing popularity for on-line grocery shopping and a gradual decreasing popularity for traditional wet markets were also observed. Global food marketing success requires exporters to have a well-developed understanding of the cultural uniqueness of their target foreign market and adapt their products accordingly to cater for the needs and wants of those consumers.

Upcoming Events

13-16 March 2001	Foodex 2001 Japan. Contact: Robyn Organ, IFB Exhibitions, Tel. (02) 9700 1400, Fax (02) 9700 1644.
25-29 March 2001	1st IWA International Conference on Odour and VOCs: Measurement, Regulation and Control Techniques, UNSW, Sydney, Australia. Contact: Lance Bowen, Tel: (612) 9385 5947, E-mail: lance@civeng.unsw.edu.au, Web page: http://www.odour.civeng.unsw.edu.au.
25-30 March 2001	The Eighth International Symposium on Olfaction and the Electronic Nose - "ISOEN 8". Contact: Ph: (609) 737-1902, Fax: (609) 737-2743, email: ecs@electrochem.org.
28-30 March 2001	10th Australian Food Microbiology Conference - Food Microbiology in the 3rd Millenium. Carlton Crest Hotel, Melbourne. Contact: Alison Johnson, Tel: (03) 9731 3417, Fax: (03) 9731 3201, alisonjohnson@foodscience.afisc.csiro.au.
25-29 April 2001	**The Association for Chemoreception Sciences (AChemS)**, Sarasota, Florida, USA. Contact: http://www.achems.org/Conference2001/confindex.htm.
6-11 May 2001	Gordon Research Conference on Chemical Sensors and Interfacial Design. Ciocco, Italy. Contact: http://www.grc.uri.edu/programs/2001/chemsens.htm. Online application: http://www.grc.uri.edu/attend.htm.
13-15 June 2001	**Cognition and the Chemical Senses: Associations, Expectations and Interactions**. The Marriott Lincolnshire, Lincolnshire, Illinois. Contact: Dr Subba Rao, Tel: 414-931-4970, email: Rao.Subba@mbco.com, On-line registration: www.meetings-centives.com/miller/beersymp.htm. Registration closes May 1, 2001.
1-4 July 2001	34th Annual AIFST Convention and Exhibition. 2001: A food Odyssey. Adelaide Convention Centre. Contact: AIFST, Tel: (02) 9959 4499, fax: (02) 99544327, email: aifst@aifst.asn.au, web: www.aifst.asn.au.
22-26 July 2001	**Pangborn Sensory Science Symposium**, Dijon, France. Contact: www.dijon.inra.fr/aromes/pangborn.
22-29 Aug. 2001	XXVII International Ethological Conference, Eberhard-Karls Universitat Tubingen, Germany. Contact: http://homepages.uni-tuebingen.de/ethology01/ email: ethology01@unituebingen.de fax: +49-7071-294634.

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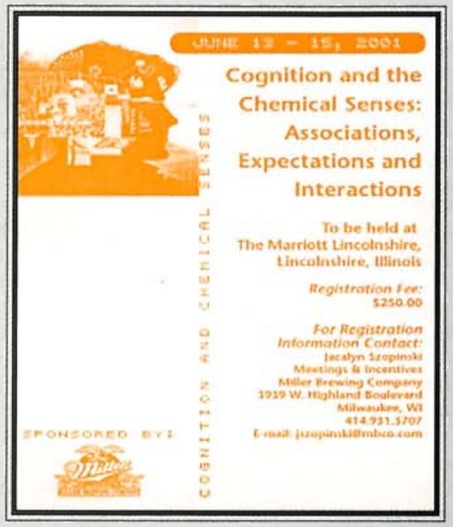

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ChemoSense (ISSN: 1442-9098) is produced and published quarterly by the Centre for ChemoSensory Research, University of New South Wales, Australian Technology Park, Sydney, Australia 1430

Production: This issue was edited and produced by Graham Bell, Carol Fleet and Hae-Jin Song

Subscriptions: Annual subscription A$52, postage inclusive.

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