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ChemoSense

Editorial

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ChemoSensory science can find many contexts in which to have significant impact.

Our main article deals with the slow deterioration of these senses over time in the later part of a person's life, and why it will profit health service administrators, carers and food providers to understand these changes and meet the challenges facing them.

However, the situation is now more interesting in affluent societies, where people over 60 years of age are, or will soon be, "cashed up" and educated as never before. They expect the fine things of life that they have worked for and achieved to continue for the rest of their lives.

These expectations cannot be met by continuation of the status quo in their lives while their physiology ages and their sensory systems go into decline. It is therefore imperative to provide for these growing needs with solid systematic science in this field, from which will flow helpful, profitable technologies and a welcome reduction in health care costs.

A cultural and personal perspective,

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Dynamics of Food Flavour Perception in the Over 60s:

New Implications for Food Design and Diet for Older People

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Introduction

Flavour perception is a multimodal phenomenon in which several independent sensory systems are integrated by the central nervous system to produce experience of food (or drink) in the mouth which we know as flavour (see the recent book by Taylor and Roberts (Eds.), 2004, and its review by Bell, 2004). As a person reaches a mature age, beyond 60 years, the constituent sensory modalities contributing to flavour perception begin to fail. Perception of flavour becomes attenuated or radically altered, often with negative consequences for general safety as well as for good nutrition and health maintenance of the aged person (DeVere, 2003; Reiter and Costanzo, 2003). This review will draw

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by psychologist Jenni Ibrahim, is provided on the strange case of the "stinking durian", a popular fruit of South East Asia.

This issue also contains an exclusive and privileged review of the movie "Perfume" by the language scholar Hans Rindisbacher, who has made a life's study of the representation of olfaction in literature. We can learn from intelligent consideration of the role of smell in culture, as reflected in the arts, and now in movies ■

Acknowledgement:

The Editor wishes to thank Peter O'Brien for introducing him to the literary work on olfaction, of Hans Rindisbacher. Peter is a former UNSW administrator, who lives at Thirroul on the NSW south coast in a house opposite that occupied by D H Lawrence during his writing of "Kangaroo".

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on recent literature from the following main sources:

1. The work of Schiffman and colleagues (spanning about 30 years)
2. The umami literature and information emanating mostly from Japan
3. The European HealthSense Program
4. Scientific experiments with humans and animals on chemosensory psychophysics, cross modal interaction, adaptation, mixture suppression and synergy
5. The recent large European Community Program on sweetness
6. Scientific work on receptors and basic physiological mechanisms.

The review looks at implications for food product development and marketing to the critically important "Older Person" which now includes "Baby Boomers" (born between 1945 and 1955) with new levels of affluence, education and an ability to spend money to sustain their already-achieved quality of life.

Decline in Chemosensory Perception in the Older Person

There is general agreement that sensory function involved in the enjoyment and palatability of foods declines in people after age 60. For some individuals, perception declines slowly and is only slightly attenuated at 80 years of age, while in others it declines rapidly and disappears by 75. The loss is complicated by gradual onset of degenerative conditions such as Alzheimer's disease and other dementias, cancer, the taking of medicines, surgery and the many medical treatments required by the older person. Chemosensory deficits can alter the motivation to eat, the kinds of food chosen, exacerbate medical conditions, impair nutritional status, and result in loss of weight and immunity to infections. In addition, some medicines and interventions, such as radiation, can exacerbate the loss of perception of flavour in the elderly (Schiffman, 2000, Schiffman and Zervakis, 2002).

Olfaction and Gustation, the Core Sensory Modalities for Flavour Perception

Although flavour is a multi-modal perception involving five or six separate sensory modalities (see Taylor and Roberts, 2004), this review argues that the chemosensory modalities of olfaction (smell) and gustation (taste) are the core constituents of flavour perception. Other sensory systems (trigeminal, texture, temperature) contribute "cues" to round-out or supplement the flavour experience, but are not essential to its production. An analogy to flavour perception exists in a case of monomodal perception: the brain integrates two independent inputs, namely, the laterally displaced and slightly different visual fields of each eye, to produce depth perception, a distinct experience of being in three dimensional visual space (Bell, 2004). Several types of visual information supplement the unique experience of three-dimensional visual space, and are called "cues" to depth perception (these are well known and are commonly dealt with in classical texts on visual perception). Examples of these non-essential cues to depth perception are visual masking of distant objects by near ones, relatively greater apparent movement of near objects when the head is moved sideways, visual texture gradients, linear perspective (distant objects appearing smaller), and aerial perspective (distant objects becoming fainter and blue coloured). However, by covering one eye, the profound experience of depth disappears and the supplementary cues provide only a flat, partial "illusion" of depth experience. This review argues (in the light of the papers compiled by Taylor and Roberts, 2004) that olfaction and taste are analogous to the separate inputs of each eye, and olfactory and gustatory inputs *brought together* in the brain, are *essential* to creating the unique and profound human experience of flavour. In aging, when either olfaction or taste (usually it is olfaction) is reduced or disappears, the experience of flavour is profoundly disturbed or destroyed.

It is therefore important to know what losses in olfaction and gustation might be expected in the aging person, if steps are to be taken to maintain good nutrition and health in the elderly that follows from the perception and attendant enjoyment of the flavour of food.

Olfaction

Of the chemosensory systems that decline in old age, olfaction is the most profound.

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Total loss of olfactory acuity is common in the aged. With it comes loss of enjoyment of food, loss of appetite and decline in nutrition. Losses commonly become clearly noticeable after age 70 but start as early as 60. There is much documentation gathered over three decades, of these effects, particularly from the extensive normative studies by Doty and others for the UPSIT smell acuity test (see review, Doty 2003). UPSIT test scores for healthy adults over age 70 are generally 60 to 70% those of younger people. More than 75% of people over age 80 have difficulty perceiving and identifying odours.

The literature contains a set of studies on aging and food appreciation by Schiffman and colleagues (see review, Schiffman 2002), which indicate that healthy eating can be improved significantly by the addition of tasteless odorants to meals. The added odorants, alone, were shown to improve grip strength and immune system indicators in nursing home residents (>80y). It is not known why odorants should positively affect the immune system. The amount of extra odorant added was around ten times perceived intensity as that of "normal" food.

The Gustatory (Taste) System

The literature on the aged person shows that taste is usually partially deficient in the primary tastes (sweet, sour salty, bitter) and in their perceived strengths relative to one another. A series of experiments by Mojet at al (2001, 2003) provides important information on the effect of aging on the gustatory system.

Comparing two groups of adults, 19-33 y and 60-75 y, Mojet et al (2001), found that detection thresholds for NaCl, KCl, sucrose, aspartame, acetic acid, citric acid, caffeine, quinine HCl, MSG and IMP generally declined in terms of poorer detection levels, with age.

There was no direct effect of gender, but there was an interaction between age and gender, with older men having the greatest deficit. The extent of the deficits in older subjects required 1.32 (for aspartame) to 5.70 (for IMP) times higher concentration of the tastants than the younger subjects.

In their second series of experiments, Mojet et al (2003) studied supra-threshold intensity ratings for the same age groups and compounds, dissolved in water and several food products (ice tea, chocolate drink, mayonnaise, tomato soup, and bouillon). In addition, subjects either wore a nose clip or not. Relative perception (intensity discrimination) was resistant to the effects of aging, but absolute intensity ratings decreased with age for all tastants in water but only salty and sweet in a food product. Salty taste was the most vulnerable to age. (Note that data published by Schiffman and Zervakis (2002) that shows that salt (NaCl) thresholds are the most robust over normal lifespan. There is probably a different mechanism being measured in threshold measurements versus intensity discriminations). The effects found by Mojet et al (2003), were generic and not compound-specific within a taste. The young subjects *with* nose clips performed as poorly as the older subjects, *with* or *without* nose clips. This shows that loss of taste acuity in older people is related to loss of *olfactory* ability. This is an astounding new finding in the field of chemosensory research and aging. It implies that the declining *olfactory* sense effects the perception of flavour through both the olfactory *and* gustatory systems.

Salience of Tastants in Mixtures

Mojet et al., (2003) also showed that relative taste perception in mixtures of tastants changes quite radically in the older person: e.g. the young adults perceived salt tastes as stronger than other tastes while the reverse was true in the older group. The older group perceived intensity contrast between salt and bitter as smaller than the young group. These contextual effects are generally poorly defined and this is an important demonstration that taste stimuli behave differently in mixtures or taste contexts, in the older subjects. Thus, food formulations optimised for the older consumer will taste "wrong" to the younger person. The important lesson here is that meal designers (unless in the older age bracket) must not use themselves or younger adults as assessors in the development of food products for the elderly. This informs policy, where younger adults are carers and cooks for older persons. It can be expected that 2 to 4 times the intensity of saltiness will seem "normal" to the older person (Mojet et al, 2003). Meal designers will have to be sensitive to what changes are effected by changing balances in taste mixtures as perceived by the older person. This is not yet well documented in the literature.

Taste and Smell Interaction

Flavour is the word given to the complex interaction of the chemosensory information coming from food in the mouth, as well as the temperature, texture, mouthfeel and other non-sensory contributions, such as expectation and memory (see reviews by Keast et al, 2004 and Prescott, 2004).

A sub-program of the recent multi-laboratory European HealthSense Program has been resourced to gain insight into the interaction and compensation mechanisms between the senses, and to guide European food manufacturers in formulating foods for the emerging "gray" market (see Tourila et al., 2001; Forde and Delahunty, 2002).

Removal of one component of the flavour mix of sensory inputs (through aging or injury) can impair or reverse enjoyment of flavour. Without the fragrance of strawberry, it is hard to believe that the flavour might be restored by intensifying the sweetness. However, understanding how the various systems interact might assist in developing strategies to minimise consequential loss to other component systems, and maximising use of what

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might remain of the damaged system.

Evidence of the interplay between smell and taste is growing:

Stevenson at al (1999) showed that when an odorant is added to a sweet solution it might enhance the taste of sweetness or suppress it. Odorants which had a "sweet smell" such as caramel, had the greatest effect on sweetness intensity rating of the sweet liquid and suppressed the perceived intensity of a sour liquid. Hence, we can expect loss of aspects of other systems as another system fails. So, compensation for, or intensification of a failing system (e.g. olfaction) must be seen as an action to restore balance in the whole multimodal flavour system. It remains to be shown that intervention that might succeed in rebalancing the system and restoring a degree of normality, and then whether or not there is benefit in early, as against late, intervention.

The Trigeminal Sense

In the older adult, the trigeminal or chemesthetic sense, which registers "burn" in chilli etc, or cooling in menthol etc, is not much affected by aging (Forde and Delahunty 2002, Laska, 2001). Indeed the elderly person's sensitivity to spices can increase above that of younger adults, due in part to the greater likelihood of oral lesions and dryness in the mouth. Loading their food with spices, in an attempt to compensate for other sensory loss, is therefore ill-advised. It should also be noted that over salting food may reach a point of stimulating the trigeminal chemical sense, and thus make the product burn unpleasantly. Spices may help to emphasise that the food is tasty to the older consumer, provided the spice intensity is no greater than that tolerated by younger adult consumers. Too much capsaicin in the spice will serve to suppress taste, which is counter to the objectives of enhancing taste in products for older people (Simons et al., 2002).

Texture and Heat Sensitivity

Perceived texture and temperature of foods may, for the same reason as applies to the trigeminal sense, be exaggerated in the older consumer (Forde and Delahunty 2002). There is belief but not much evidence, that texture can make food more interesting for the sensory impaired older person. A robust temperature detection ability suggests that foods and beverages should be presented at appropriate temperatures for all adult consumers.

Incidental Learning and Memory

Recent research on influence of memory on smell and taste (Koster et al.,2004) suggests that expectation, colour, memory and other non-sensory factors (incidental learning) all play a part in chemosensory perception. In addition, recent research with functional magnetic resonance imaging (fMRI) has revealed brain areas which integrate odour sensation with emotional and verbal components of odours. These cortical areas (anterior cingulate and medial orbitofrontal) can be activated (weakly) by a positively associated word in the absence of the odour stimulus (de Araujo et al., 2005). Koster et al., (2004) showed that older persons are as good as young adults at using this "adjunctive" information in taste perception (sweet, sour and bitter). Long term memory is retained well, even into senile dementia. This implies that food for the older consumer should be true to expectation: carrot should look like carrot, etc. Memories of food will be wholly or partially validated in older consumers with chemosensory loss, and this will increase the complaints about food quality. Schiffman (2000) found complaints about the food quality were dramatically reduced when the flavour was enhanced. In the right circumstances, older people may be able to use their memories to bolster their enjoyment of food. Research is needed to test this hypothesis.

We can expect the young healthy person to smell food prior to putting it into his mouth, while the elderly person may receive no such chemosensory information: a food will have little or no signal value until it is in the older consumer's mouth. This implies that attractive visual presentation of food for the elderly may aid their dietary habits and facilitate better outcomes with regard to unattractive, unsafe food.

Sensory Enhancement and Compensation

The massive use of and cost of sucrose in food and beverages and the discovery of non-nutritive sweeteners, has motivated food research to find combinations of sweetness formulations that might have an equal or greater effect at lower cost, than sucrose. Saccharin is approximately one hundredth the price of sucrose but is 300-500 times sweeter. Where taste sensitivity is attenuated in the elderly, non-nutritive sweeteners suggest a way of boosting taste without undesired nutritional consequences.

The EC has funded two programs to understand sweetness: "The Mechanistic Understanding of the Sweetness Response" (AIR3-CT94-2107), which ran from 1995 to 1998, and was followed by "The Optimisation of Sweet Taste Quality (TOSTQ) which ran from 1999 to 2001.

These two large research programs have advanced understanding of fundamentals of sweetness, physical behaviour of molecules in solutions, models of receptor and ligand characteristics needed to design new sweetener molecules, the evolution of sweetness receptors in the animal kingdom, and the synergistic and suppressive outcomes of mixing sweeteners. The latter is important to perception of flavour by the elderly: synergy occurs in some combinations and suppression in others. The rules determining these outcomes are still not understood.

Sucrose in solution facilitates the release of volatiles, according to the EC studies, while non-nutritive sweeteners tend to suppress it. Hence, a food made with non-nutritive sweeteners will need intensified aroma to have equal flavour to one made with sucrose, and even more if it is intended for the elderly.

Considerable effort has also been invested by Schiffman et al., (2002, 2003), to discover rules determining synergy in binary and ternary mixtures of sweeteners. They showed that sweetness measurements are attenuated by repeated exposure - after several sips the solution is not as sweet as at first. Certain ternary mixtures were found that were 99.4% sweeter than any

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binary mixture, but also reduced the decline in sweetness intensity experienced over repeated exposure (Schiffman et al., 2000, 2003).

Enhancing flavour perception by priming the receptor mechanisms has been attempted by some researchers. Aroma is intensified if sniffed while a sweet liquid is held in the mouth (Schiffman, 2000) and taste of sweetness is increased if (tasteless) aroma of strawberry, caramel, etc, is added to the sweet solution (Stevenson et al., 1999). So, aroma that precedes ingestion might prime the person's expectations, their taste system, and their digestive juices, provided the person was not smell impaired. The suggestion from this in terms of food for the elderly, is that maximising the involvement of sensory systems before and during the eating experience might positively enhance the overall flavour experience.

The implications for some of this work for the aging human include:

- A role is indicated for non-nutritive sweeteners in calorie-controlled foods for elderly people concerned about unwanted weight gain (common in aging men, particularly after retirement) and reducing risk of Type 2 diabetes.
- Sucrose might be used to potentiate the flavour of food for the elderly, through its volatile release properties, provided their olfactory loss is minimal.

Umami

Umami is now the accepted name for the *savoury* taste imparted by glutamate and 5'-nucleotides such as inosinate and guanylate (MSG, IMP and GMP), substances which occur naturally in many foods (see the convenient short review by Ninomiya, 2003, or the collection of papers by Yamaguchi, 1998).

The effect of umami compounds in foods is increased palatability (Prescott 2001, 2002, Okiyama and Beauchamp, 1998). They may also confer information that the food has energy value (Prescott, 2004). Liking of food with added MSG is increased in most consumers, even those who know and disapprove of the food having "added MSG" (Prescott, 2002).

Umami is often referred to in the chemosensory literature as a "basic taste" with its own receptors on taste receptor cells, serving an evolutionary advantage in the recognition of proteins in food (see appropriate references in Ninomiya's 2003 review). Umami signal transduction is probably a collective property of a number of cells within the taste bud (Brand, 2000). Such an arrangement would provide a mechanism for synergy, of use to the elderly, whereby blends or mixtures of umami compounds would assist in stimulating multiple taste cells.

Maximising umami in many foods seems an obvious strategy for enhancement of prepared meals and sauces for adult consumers, both young and old. The market resistance to added MSG can be overcome by balancing the ingredients to maximise natural umami compounds. Some of these are listed by Ninomiya (2003), however, more information is needed.

Umami compounds not only enhance taste but increase the savoury flavour of food, stimulate salivary flow, and add to the sensations of "fullness, impact, mildness and thickness" (see various studies reviewed by Ninomiya, 2003). This makes them obvious candidates for enhancement of food for older consumers, to compensate for sensory loss, as well as improve food intake and nutrition.

It should be noted that some humans cannot taste monosodium L-glutamate (MSG) and appear to be specifically taste blind (ageusic) to the substance (Lugaz et al, 2002). Up to 19% of a population may be in this category. Use of MSG as a taste enhancer will therefore "not work" for one in five people. This requires further investigation, and a screening protocol to identify non-tasters in groups of judges where MSG is of importance. In addition, normal age-related decline in sensitivity for L-glutamate can be anticipated in the remainder of the population (Moyet et al., 2003).

Addition of umami compounds to food increased food intake in the elderly, and a number of nutritional and immune parameters (Schiffman 2000, 2002, Schiffman and Warwick, 1993). There is little indication of what the optimal dose should be above the normal level of 0.1% (100mg MSG per 100 gm of food) to 0.8% MSG in normal (younger) adults (with no increase in effect above 0.9% as shown by Yamaguchi, 1987 in Ninomiya 2003).

The synergistic interactions between MSG IMP and GMP found in adults (reviewed by Ninomiya 2003) do not apply to the older consumers or to the same extent (see Schiffman and Zervakis 2002, their Table VII) and more research is clearly needed when products are being formulated. The natural composition of beef, pork and chicken indicates some commonality in the ratios in which the compounds occur in different meats, which may provide a guide to enhancing food flavour for the elderly.

Palatability of food (soup) was improved by MSG at levels between 0.1 and 0.8% and declined after 0.9%, in a way similar to added salt (NaCl) (Yamaguchi, 1987 in Ninomiya 2003). MSG can enhance the palatability effect of salt by the addition of so little MSG that the sodium content of the meal can actually be reduced substantially (Sakamoto, 1997 in Nanomiya 2003). MSG may therefore be a benefit to the older consumer by substituting a small amount of MSG to compensate for the need to add salt, which declining salt sensitivity causes.

The decline in normal interactions in taste mixtures (Mojet et al., 2001, 2003) caution against the assumption that the synergies will work in the same way or at all in the older consumer. Further research is needed.

Schiffman and colleague's work suggests that all meals for older subjects can be enhanced with umami compounds. These can be added as natural ingredients. Some published tables are available of MSG, IMP and GMP content of various food ingredients (Ninomiya 2003). Taking the data on beef, say, as a total of the umami compounds of 80mg per 100g beef, then the meal could be enhanced "safely"* to normal adult level by a further 720 mg/100g (800 minus 80) of meal contents. This could be achieved by adding appropriate proportions of tomato, cabbage, spinach, corn, etc., which contain 246, 50, 48 and 106 mg of free glutamate per 100g, respectively (Ninomiya 2003). A

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meal can thus be maximised for umami compounds without any "added MSG".

*The upper levels of added MSG, determined by Schiffman (2000) were 0.3% to 1.0% depending on the degree of taste loss for each subject.

In their study of age, food flavour enhancement and the salivary immune response, Shiffman and Miletic (1999) added MSG to foods for young and old as follows (% conc. w/w):

The increase from young to old groups in concentration of MSG was varied widely from 1.87 times the concentration (onion soup) to 13.33 times (carrots), presumably owing to differences in the MSG concentration naturally occurring in each product. These differences caused an increase in immune response in the elderly group. This begs the question of whether it is advisable, in terms of nutrition, to add sodium in the form of MSG at concentrations 13.33 times normal level, for the sake of enhancing flavour in a few humble carrots. Clearly the practice of flavour enhancement for the elderly needs careful consideration. For example, adding a slight sweetness to the carrot, instead of the MSG, may produce a more palatable and healthy outcome for the elderly.

	Group		
	Young (25.1+/-1.5y)	Old (73.2+/- 2.1y)	Increased conc. (O/Y)
Corn	0.3%	3.5%	11.67
Carrots	0.15%	2.0%	13.33
Chicken broth	0.6%	2.0%	3.33
Onion soup	0.8%	1.5%	1.87

Dietary Fat

Perception of dietary fat has long been considered an important attribute of flavour, a texture enhancer, useful for moisturising breads and cakes, tenderising meat, making ice cream creamy and chocolate so desirable as to be almost addictive. Aristotle postulated that fat was a taste in its own right (Mattes, 2003).

The importance of fats in the human diet derives from the calories obtained from fats and oils, which accounts for 38% of calorific intake in Western diets (Akoh, 1996, cited by Song 2000). When people cannot or will not obtain fat from animals, they derive it from plants. Humans appear to be universally driven to consume fat.

Fat in the mouth has enormous internal (to one's body) signal value, possibly indicating that energy is available to be burned. Mattes and others (Mattes 2003) showed in humans and animals that mere stimulation, but not ingestion of fats in the mouth triggered raised triglyceride levels in the bloodstream. This showed that the release of triglycerides into the bloodstream (making calories available for burning) is effected by the sensory signal of the fat in the mouth, and must therefore be governed by the brain rather that the body: it is a cephalic response rather than a somatic one. What becomes of this signalling effect that something good has happened in the mouth, in the older person? Does it disappear with loss of chemosensory acuity? If not, can it be used to enhance the perceived value of food to the older person? Evidence is lacking. Cephalic responses may not be confined to dietary fats, but dietary fats may have special importance in exploiting cephalic responses for improved health and diet in older people.

Even if a food is *unconsciously* registered as having a favourable nutritive consequence, its hedonic value is increased (Scott, 2001). What constitutes a positive nutritive consequence for an aging human may be nothing like that of a younger adult. The nutritional deficiencies of the older person may point the way to enhancing hedonic value of foods by skilful inclusion of ingredients that, despite their initial paucity of perceived flavour will, with repeated encounters, become more acceptable to the older person. This remains to be tested.

When fat is removed from foods, those without fat but of equal calorific value seem to lack flavour. Fat has been postulated to be a catalyst for the release of flavour, a conjugate for the carriage of flavorants to their receptors and as a tastant acting on its own receptors in taste receptor cells (see reviews by Gilbertson, 2003, Mattes, 2003, Song, 2002 and 2007). How fat might work as a flavour enhancer has bedevilled food chemists who have tried to design molecules that might perform its flavour functions but not its nutritive ones. Nothing else seems to retain the flavour of food as well as natural dietary fats, and modern food technology, in defeat, has tended to turn to educating consumers to like "lite" or reduced fat foods for their own sake (and health benefits) rather than accept non-nutritive fat substitutes which don't quite emulate the natural, full-fat product.

Gilbertson and colleagues' discovery that fatty acids can depolarise taste receptor cells (Gilbertson et al, 1997) showed that fat might play a direct part in interacting with the perception of tastants, akin to that of umami and "savoury" or protein-indicative flavours, via fundamental taste receptor cell mechanisms. At this time, fats have been shown to interact in various interesting ways with tastants and with umami compounds (Song 2007) but whether these important phenomena are sustained in the aging human has yet to be determined.

The role of fat in enjoyment of food flavour in the older person remains to be explored properly, as does the enhancement of food preferences that redress dietary deficiencies. With the increasing buying power of the over 60s, it might come as a surprise to food providers to learn what the older person *feels like eating* from day to day. A good way to start research on this would be to ask them.

Other Enhancers

(+)-(S)-Alapyridaine, a tasteless product of heated sugar/amino acid mixtures has been reported recently by Soldo et al., (2003) to have general taste enhancing properties. Also found in beef bouillon, it is able to enhance several taste qualities including sweetness, umami, and saltiness (but not bitter and sour). It also increased known synergies such as L-arginine on the salty taste of NaCl. This offers promise of enhancing perception of flavour in the

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elderly.

Work in catfish chemosensory systems (Caprio et al., 1989) suggests that compounds that cross-adapt will also enhance each other. This needs further work in humans, the construction of lists of compounds and their synergistic relatives and tests of their effectiveness in food systems. A better understanding of key flavour compounds for various foods of dietary importance to the elderly, and what might improve their performance in intensifying the characteristics of the aroma, and hence flavour, is needed.

Research continues to reveal interesting relationships between flavour ingredients that might aid the perception of flavour in the elderly. This process is greatly facilitated by the contribution of research into the basic nature of perception of flavour, its multi-modal sensory mechanisms and the higher brain processes by which flavour's unitary and unique experience becomes integrated.

Implications for the market place: Considerations for translating knowledge of sensory dynamics in the Over 60s into benefits, through commercial products.

Despite everything that is known about the aging demographics in developed markets, it is rare to find any branded food that adequately delivers any of the above benefits to the older person. Here, we discuss:

- the market
- need states
- product development considerations
- consumer marketing considerations

The Market

By year 2025 there will be about one billion people in the world over 60 years of age, and in developed countries and regions, such as Japan, North America, Europe and Australasia, the over 60s will constitute around 25% of the population (Schiffman 2000). Unlike previous generations of elderly, aged people in the developed world can expect to have *considerable buying power*, and expectations consistent with their younger compatriots on matters such as health and lifestyle, including food quality and convenient access to it. This group therefore represents a significantly lucrative, emerging market segment, as well as a large sub-population creating upward pressures on a nation's health costs.

Yet the global market is only just beginning to respond. Of the many thousands of new products launched globally since mid 2003, market reviews - although not exhaustive - have found only 24 product/range launches with claimed positioning for Older Persons in a number of countries and categories (Table 1 below). This work indicates that Japan is leading the market for the development of senior's products with China coming second. Western markets appear to be behind with only 5 products/ranges identified in total.

Perhaps this is not surprising. 19% of the Japanese population is already over 65. Indeed, in April 2002, Japan Care Food Conference established a "Universal design" food logo and four different standards for Universal Food have been defined. A clear consumer need in a growing segment and market-leading innovation are excellent indicators of an emerging market opportunity.

Table 1: Product launches, 2003 and later. Products positioned to Older Persons by market, category and related claims (source: Strauss, various professional market observations).

Launches by market (total = 24)		Launches by category (total = 24)		Launches by positioning (>1 /product as claimed)	
Japan	9	Dairy	7	Reduced/ low / no	10
China	8	Processed Protein	4	Calories	3
Italy	2	Breakfast cereals	3	Fat	3
Malaysia	1	Prepared meals	2	Sugar	3
Russia	1	Snacks	2	Sodium	1
Sth Korea	1	Sauces & seasonings	2	Fortified/ nutritious	8
Spain	1	Confectionery	2	Convenience	5
USA	1	Side dishes	1	Functional (w3, pro)	5
		Spreads	1	Dentition	3
				Taste	3
				Low sweetness	2
				Traditional	1
				Easy open	2

What stands out from observing the market is the gross lack of development in the West and a general failure to capitalise on the element of flavour across all markets.

There are early indicators in Western markets that manufacturers are beginning to acknowledge the seniors' segment but have not yet addressed it directly at a significant level. ConAgra has a frozen range of prepared meals on offer in the US. At the 2004 "Seniors Exhibition" in Sydney, Australia, Unilever had a notable presence with its ranges of general diet/weight loss and cholesterol related products. Curiously, the most popular part of Unilever's stand was the ice-cream section. Enjoyment of the combination of cold fat, milk and sugar seems to change very little from childhood to senior years.

Nevertheless, increasing chemosensory impairment in the growing aged segment of many Western food markets, are bringing demographic and economic pressures that will challenge future food science and technology (Delahunty and Elsner, 2001; Morrisey et al., 2001) and present opportunities to marketers and manufacturers.

Increasing costs in maintaining an aging population makes it important to increase and consolidate scientifically derived knowledge on the dietary habits and consumer needs of the 60+ age group. There are specific nutritional issues around aging. So any responsible marketing and product development should include provision for the flavour and the nutritional quality of such consumer-specific products. The buying power of the next generation of older person should provide sufficient "market pull" to drive research and development in this area. How can these emerging needs and wants start to be understood?

One strategy for screening the nutritional status of the elderly is "The Australian Nutrition Screening Initiative" (ANSI) based on an acronym of check point: "DETERMINE". In Australia, "Dietary guidelines for older Australians" was created by the Nutritional Health and Medical Research council in 2000. The aim is to assist older Australians on diet and lifestyle using the following guidelines. A number of issues relating to food intake in older people can be identified that differentiate this segment from other consumers:

Product Development Considerations

Market researchers tend to agree that pivotal to the success of any food product is flavour. It is the key product parameter in determining product re-purchase and a primary target of promotion, through tasting demonstrations or "tastes great" advertising.

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continued

Issue	Situation	Need state (using positioning nomenclature above)
1. Adequacy of intake volume	Flavour impacting palatability; Diminished olfaction reducing ability and motivation to cook; Difficulty in preparation; Lack/cost of convenience; Physical eating difficulty; Ability to procure; Loss of partner/know-how	Taste (and "cooking smells") Convenience Easy open/packaging Dentition
2. Adequacy of nutritional content/balance	Lack of nutritional/food knowledge; Lower portion sizes with reduced energy needs	Reduced/ low / no Fortified/ nutritious
3. Functionality	Changing needs provide opportunities for enhanced quality of life	Functional (incl. Omega 3's, pro-biotics, plant sterols)

There are a number of product forms/occasions that appear interesting to target:

- Complete meals for convenience and nutritional security
- Condiment sauces and seasonings to enable individual tailoring
- Cooking/sizzling sauce to drive aroma during cooking
- Easy to use meal components, carriers for appropriate fortification
- Packaging innovation around ease of opening and/or taste-interactive packaging

Meal and sauce formulation for older consumers can be expected to be very different from those for the younger adult. Enhancement by addition of aromas is used at up to ten times strength of that considered optimal for young adults, and by addition of up to 3 or 4 times the normal amount of tastants (e.g. salt, acid, sweetening agents and bitter flavours) may be necessary to normalise the perceived balance of tastes in the older person. These formulations might produce taste/flavour profiles that are disgusting to the young adult (carers, chefs and product developers), yet they will be optimal for the enjoyment of the food by the older consumer.

Along with re-balancing key flavour components, flavour enhancement will be a feature of products developed to optimise taste for Older Persons. The level of taste enhancers (umami compounds) optimal for inclusion in sauces and finished meals could be of the order 0.2 to 0.8% w/w, probably towards the higher boundary of this range. It may be that the image of MSG in the West could be improved by demonstrating benefits in enhancing food and nutrition for Older Persons.

Using a release enhancer of aroma volatiles (such as sucrose, and possibly ethanol) in micro-waveable cooking sauces and ready-to-eat meals might enhance the older person's cooking experience and pleasure of eating. There are clearly opportunities for new and creative packaging solutions that enhance the presentation of food in order to stimulate memories and expectations in the older person.

Enhancement of one system by another has been demonstrated in the basic research literature, for supra- and sub-threshold taste (e.g. saccharin) and smell stimuli (e.g. strawberry). This suggests that experience of food can be enhanced by integrating inputs from several senses. The product developer should aim to maximise the number of sensory systems used in the consumption of the product.

Ease of eating is another consideration. In Japan, two products are already available that specifically address this issue and it's one that should be considered in any product design brief for Older Persons.

Given the chemosensory dynamics that are becoming understood in older people, careful management in the practice of product development, market research and of quality control in-house is essential. Product developers and sensory assessment groups may literally have to wear pegs on their noses, or be over 60! A further significant challenge in developing meals and meal components will be accommodating what is a gradual change in target consumers' chemosensory capability.

Functional (health promoting) foods is a now an accepted part of the food developer's area of concern. It is of particular interest to older people, who have an increasing need to sustain good general health against increasing frailty. An example of a "proven" functional food is cranberry and cranberry juice, which reduces the incidence of urological infection in women, particularly older women.

Other areas of future potential for the functional food developer is the need in older people for sleep quality, and sustaining (even improving) memory and cognitive performance.

Consumer Market Considerations

Japan is leading the way in food products designed and positioned for senior citizens, focussing on physical, health and nutritional benefits. Flavour positioning is currently restricted to "low sweetness" or "traditional cuisine". Yet the critical effect of flavour on purchase/repurchase decision-making and the high impact of changes in sensory acuity in older persons, are

Dynamics of Food Flavour Perception in the Over 60s:
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continued

Case Study

Golden Cuisine:
from the kitchens of ConAgra

'Providing quality seniors meals that are nutritionally balaned and delicious!"

From the ConAgra web sites: http://www.goldencuisinestore.com/index.jsp and www.conagrafoods.com/brands/golden_cuisine/index.jsp

Golden Cuisine was formulated by product development specialists and registered dietitians specifically to meet the needs of seniors. It serves consumers who have a limited ability to acquire meals by traditional means. The benchmark of quality, Golden Cuisine meals help ensure safe and delicious meals for seniors.

Numerous studies show seniors eat less and sometimes miss meals, which makes it even more important that they eat nutrient-rich foods. We have made it quick and easy to send meals to a loved one no matter where they live. Simply visit our website at: www.goldencuisine.com.

History

More than 35 million people over the age of 65 currently live in the United States. By 2030 that number will double, reaching 70 million. Many seniors cannot or choose not to go shopping and must rely on caregivers to select their diet. To make this daily necessity easier, ConAgra Foods launched Golden Cuisine in 2003 ■

sufficient to warrant flavour as a primary differentiator for manufacturers wanting to define a new, growing and potentially huge market segment.

This opportunity is being further fuelled by the affluence of the "Baby Boomer" generation, which after fifty years of relative peace and prosperity following World War II, has money, is seeking fulfilment and wants convenience. Coupled with the need states mentioned above, flavour will provide the consumer key which unlocks this emerging market's potential.

Branding

A front page article in *The Asian Wall Street Journal* in 2004 highlighted both the buying power and potential of the over 60s market segment, and provided an instructive example of what not to do from a branding and positioning perspective. It recounted the market success of Sony video cameras in which the benefit of the product was clear (record children who are important to you playing - no guesswork needed: grandchildren) versus a failed opposition product that had positioned its products simply for the older consumer.

The message is clear. Don't brand your products OLD MAN brand "tastes great to really old people". Something of the ilk CONNOISSEUR with implications of high taste quality and maturity might be more appropriate. Sub-branding alluding to or representing the key point(s) of difference will help consumers understand the benefits, identify and differentiate the products. The emerging market of older people is not only the most affluent older segment in modern times, but the best educated.

Examples of sub-brands are Con Agra's GOLDEN CUISINE (implying traditional cuisine) and, from Spain, Président's MAGNESIO (where fortification with magnesium was a key point of difference).

Conclusion

Meals, and the products used for and in the preparation of these occasions, for Older Persons can be improved by heeding chemosensory research findings. Care must be taken by marketers and product developers not to assume that chemosensory systems in the (relatively) young can reflect what elderly people will perceive and prefer in the flavour of food. Applying our new knowledge, combining it with existing need states and considering appropriate product and packaging forms, branding and consumer proposition communication lessons, begins to allow a vision of the future in which the older person's market segment will be better addressed by marketers and manufacturers.

Combining improved flavour, based on evolving knowledge on chemosensory dynamics in the over 60s, with nutritional, convenience and other needs, will provide significant *competitive edge* to those manufacturers that dare to pioneer this area. Packaging innovation and appropriate branding will further enhance success in what one day will be an important segment, which will include you, the reader.

Also critical to note are the significant individual and community benefits, in terms of a lighter burden of health cost and enhanced quality of life, to be accrued in improving the product offerings to this growing market segment. So whilst there is a clear commercial imperative for manufacturers, the social benefit of advancement in this field should represent an equivalent imperative for governments, funding agencies, and researchers.

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Durian: A Chemosensory Puzzle

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1. (fruit on tree) http://www.capetrib.com.au/durian.htm

Ask a South East Asian what's the King of Fruits? Most will reply, "Why, the durian." The exquisite flavour cannot be matched. It's sweet, rich and creamy, unlike anything you've ever tasted.

Ask a Western visitor to South East Asia about durians and you'll hear phrases like:

> "Shaped like a hedgehog: smells like manure
>
> "Stinks like ...a clogged drain, unwashed socks, a sewer full of rotting pineapples"
>
> "Like eating ...sweet custard in a sewer...strawberries in the outhouse"

You get the idea.

Durian, in the Malaysian and Indonesian languages, means "thorny", a none-too-subtle name for a fruit with a none-too-subtle odour. The thorny reference comes from the thick outer husk, which is yellow-green to light brown, depending on the species and its stage of maturity.

But it's quite a chemosensory puzzle. While its flavour is out of this world, the odour is, frankly, repellent, at least to novices.

Google "durian" and you'll get 2 million hits (March 2007). You'll discover eccentric websites entirely devoted to all things durian. Even the Australian Rural Industries Research & Development Corporation had a durian industry plan for northern Australia back in 2002!

Chemosensory scientists have the beginnings of an interest in durian. It was mentioned at the 2006 Chemosensory Perception Conference in Geneva as a "notorious example" of the way "different cultures judge smells differently."

I'm here to tell you there's more than culture to the durian phenomenon. Although I am not a chemosensory scientist, I did train in psychology, and have plenty of first-hand experience with durians. I've been visiting Malaysia for the past 35 years, living there for a decade. In my view the opportunities for relevant and interesting research are wide open.

Durio zibethinus grows in tropical forests on tall trees - up to 50m high. The oval shaped fruit themselves can get to 40cm long, 30cm diameter and more than 5kg in weight.

Inside the fibrous husk white pockets contain the delicious edible portion - pale yellow to golden gooey flesh surrounding large seeds, sometimes eaten after cooking. The texture of the flesh has been liked to thick creamy custard or brie cheese.

When I moved to Malaysia in 1976 I realised quickly that, even if I didn't much like the smell of durian, I was expected to have a decent go at enjoying it - like the rest of the family I'd married into.

My Malay husband wanted to facilitate my acceptance by his family. Since cooking durian seemed to reduce its long-reaching odour, he'd take a small piece of dodol (durian toffee) and sneak up behind me when I was otherwise occupied, popping a morsel into my mouth before I could smell it coming.

Sometimes at the family meal table Udang Masak Tempoyak would be served - prawns cooked in a creamy sauce made from fermented durian (tempoyak) and chilli. In time I came to cook and eat that dish with great relish. Eventually I graduated to surprise mouthfuls of the fresh flesh - and astonished myself by really appreciating it!

Broughan (2002) argues that in naturalistic settings especially, the greater the desire for change, the greater the likelihood of an observer changing their cognitive preferences. By this would my desire to enjoy durian have influenced my capacity to learn to like the taste and overcome the odour?

During the bi-annual durian seasons we'd go out at night to try different roadside durian stalls recommended by friends, spending time selecting what looked like the best specimens (there's an art to this), and bargaining for the best price.

Besides eating from the freshly opened husks, durian is also served with glutinous rice, as a flavouring in icecream, or cooked in dodol, my durian training food, a sweetmeat made with durian flesh, palm sugar and coconut milk slowly cooked until it has the consistency of soft toffee.

I lived for a time in a wooden kampong (village) house on stilts only 20 km from Kuala Lumpur. There were a number of mature durian trees in the compound. Our landlord lived with his family in the police officers' quarters nearby. But during durian season he and his son would spend their nights in a tiny shack just a few metres from our front door, guarding the durian fruit.

Durian need to be eaten quickly - within a day of ripening and falling. Opening a durian is much easier said than done. The way I learned was to use a heavy meat cleaver or a Malay parang and something to protect the hands - a couple of thick folded cloths or a pair of heavy (clean) gardening gloves.

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Durian: A Chemosensory Puzzle continued

After splitting the durian open each half will have two or three compartments running the length of the fruit, packed with bundles (arils) of yellowy flesh, up to half a dozen in each.

What's in durian? Chemists have studied the volatile molecules of the durian and found a wide array of compounds. Some give the fruit the "oniony" smell: propanethiol, diethyldisulfide. Others provide a fruity flavour: 2-methyl.ethyl butanoate (Lee, 1980). Other chemical elements include a range of organosulphur compounds and cyclopropene fatty acids (Berry, 1980).

Compared with fruit that Australians eat, the durian fares pretty well. A cup of durian flesh is very high in Vitamin C (80% RDA[1]) - although unfortunately it has 80% more calories and 26 times as much fat as an equal volume of banana. This is unsaturated fat, of course, not the type to raise your cholesterol.

It's well known in South East Asia that it's taboo to have a big feed of durian and to drink alcohol - it could kill you. Even before I went to live in Malaysia I'd heard this of durians. A short story in the Australian Women's Weekly told how the Chinese lover of an Australian businessman disposed of his visiting business rival by plying him with whiskey and durian on a night out on the town in Kuala Lumpur. Both alcohol and the sulphur-containing compounds of durian would place a high processing load on the liver.

The durian industry is huge in South East Asia, particularly in Malaysia, Singapore, Thailand, South Vietnam, Indonesia, Philippines and Burma. In 1997 the industry was estimated at 1.5 million tonnes across producing countries and US$1.5 billion world wide (Lim, 1997).

Travelling in Thailand, Malaysia or Indonesia during durian season, you'll see roadside stalls where these yellowy-green thorny fruit fetch very high prices by local standards. Retail prices during the seasons in Malaysia are about AUD$2-3 per kilo, less in Thailand, more in Singapore. Australian producers in the Northern Territory and Queensland can receive as much as AUD8-12 per kilo (farm price) (Lim, 1997).

The flesh makes up only 20% of the weight, so in effect the Australian-grown durian flesh yields the grower AUD$40-60 a kilo! So it is not only the King of Fruits, it is also the fruit of kings - and other rich people.

In Asian hotels, airports and taxi-stands large signs prohibit these otherwise popular fruit. The residual odour can be detected in the boot of a car long after unopened fruit have been removed. The "fragrance" of a durian in checked-in luggage permeates an aircraft virtually forever. While many South East Asians just adore the rituals of eating durian, not everyone does. Some find the odour revolting; others say the flesh is just too rich.

The story of durian as a fruit of controversy began hundreds of years ago.

> "It seems at first to smell like rotting onions", said Dr Bernhard Paludanus, (1550-1633), Dutch physician and traveller.
>
> "It is such an excellent taste that it surpasses in flavour all the other fruits of the world", responded Dutch explorer Jan Huygens van Linschoten (1563-1611).

The famous Welsh-born naturalist Alfred Russel Wallace (1823-1915) carried out extensive field work in the Malay Archipelago in the nineteenth century and reportedly said

> "To eat durian is a new sensation worth a voyage to the East to experience."

What was a long sea journey for Wallace is now a short flight to Singapore or, in most Australian cities - just a trip to your local Asian grocer. Durians sold in Australia are frozen, fresh (possibly thawed), or form an ingredient in imported prepared foods.

The wide-ranging opinions on the flavour and smell of the durian are unlike those of any other food I've ever heard of. Many - including me - adore its taste, definitely an acquired one.

Many durian research questions come to mind; I hope chemosensory researchers somewhere are already working on them. This work would not only improve understanding of the chemosensory properties of durian, but in my view, it would advance current models of both odour and flavour.

1. What's at the basis of the wonderful rich taste? Does the high fat content play a role?
2. Why does it have to smell so bad?
3. How can people like the flavour when the odour is so repellent, at least at first, and when odour has a huge influence on taste?
4. In durian-producing countries how do local people develop a taste for the durian? Does it involve habituation to the smell?
5. Does acquiring a taste for durian involve a more positive association, say between social wellbeing and the pleasure of eating durian?

1. Flavour

Durian has a high fat content. Song (2002) argues that dietary fats facilitate a positive response to taste of foods because fatty acids stimulate special receptors in the oral cavity. Does this explain why people travel long distances and pay lots of money to taste the best durian of the season - those who've overcome the odour, at least!

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[1] Recommended Daily Allowance on a 2000 calorie diet

Durian: A Chemosensory Puzzle continued

2. Odour

It's thought that the strong smell may encourage wider dissemination of the seeds, increasing genetic diversity. The larger animals would be attracted by the strong odour from afar and they'd more easily overcome the thorny covering to get to the fruit inside. After consuming durian they'd be able to carry the seeds further away before excreting them.

3. Odour and taste preference

Since odour has such a major influence on taste perception, how is it that something that smells so bad (like durian) can taste so good? Does the high fat content produce such an intensely pleasurable flavour that the odour can easily be ignored?

4. Culture and learning

It is said that culture plays an important role in determining taste preferences for certain foods (Classen cited in Broughan, 2002) and that learning or association may be the mediating mechanisms. Is this cultural influence also true for smell?

Do people who acquire a liking for the taste of durian also learn to like - or merely tolerate - the smell? In durian producing countries the prevalence of durian odours in roadside stalls is hard to avoid during the peak durian seasons, so avoiding the odour is well nigh impossible.

But is getting used to a bad smell different from developing a liking for an odour you once thought quite terrible but now associate with a pleasant flavour - such as Stilton cheese or durian?

5. Positive association

What if you lived next to a sewerage plant, drove a rubbish truck or worked in a mortuary? How would you get used to these bad odours which have no particularly pleasant associations?

Odours can be emotionally powerful - the Proust phenomenon. This effect seems to be mediated by the amygdala and involve the limbic system (Herz, et al., 2004). Is this why long lost memories can be triggered by odours previously associated with the past experiences? What might this mean for the distinctive odour of the durian: something very hard to forget!

Can the social and emotional experiences and rituals associated with shopping for and eating durian influence the cultural learning process? And so do durian aficionados redefine the odour as a symbol of the pleasure of future enjoyment?

In a series of experiments with eucalyptus and lavender oils Christine Broughan (2002) attempted to separate cultural differences in odour perception between two Anglo-Celtic groups. She proposed that volatile oils had both direct (physiological) and indirect (psychological) effects and that these effects interacted with each other. Had she compared the responses of experienced and naïve subjects to the odour of durian she might have produced a more dramatic cultural difference.

Could the interaction between direct and indirect effects of an odour account for the socio-cultural preferences for tastes and smells, and for the changes which take place in people's perception of foods? For example, can this explain the changing and paradoxical effects of durian taste and smell?

There must be millions of potential research subjects in Australia who are still "durian virgins" in that they've neither tasted nor smelled it - yet. Their naivety would make it easier to distinguish the role of learning from culture.

Post Script

Just as this article was completed there is news from Thailand of a government scientist, Songpol Somsri, who has successfully produced an odorless - but still very flavourful durian. He's spent 30 years interbreeding more than 90 varieties to produce a durian which he expects will have more appeal to overseas markets, and, surprisingly to Thais who don't like strong smelling things! The idea of an odorless durian will probably be an anathema to most other South East Asian durian lovers who continue to savour the paradox of the smelly durian with the divine taste.

Post Script Reference

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http://www.iht.com/articles/2007/03/30/news/durian.php ■

2. (opened fruit) Nina Ford and Syed Khalil bin Syed Ibrahim

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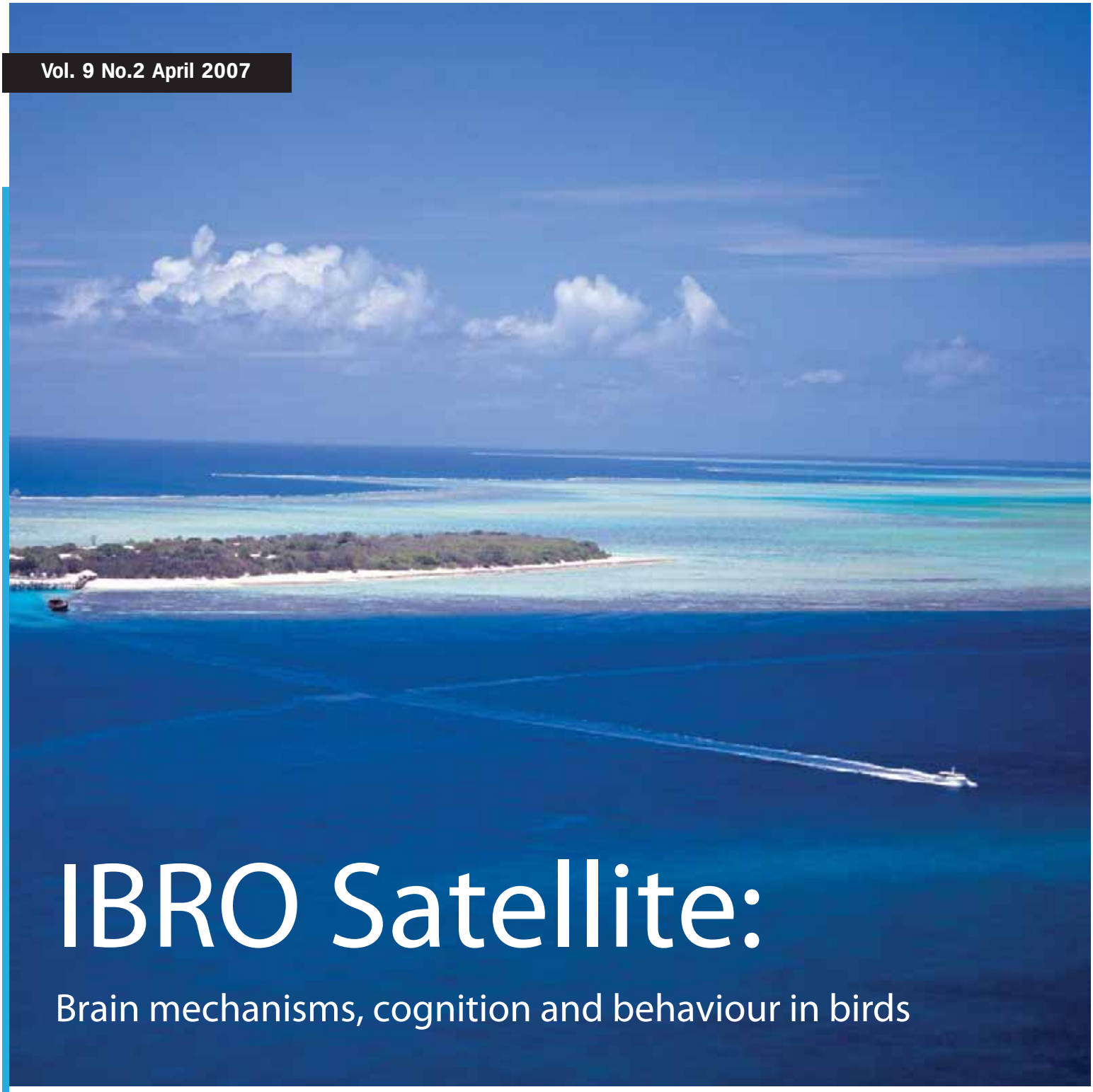
The Author: Jenni Ibrahim was born and raised in Australia and gained a PhD in Psychology from La Trobe University, Melbourne in 1976. She married into a Malaysian family and lived and worked for many years in Malaysia before returning to Perth, WA, as a senior public servant. Jenni recently retired to write and pursue community interests, representing the perspectives of health consumers, and to research her family's history, which she regards as "an addiction".



IBRO Satellite:

Brain mechanisms, cognition and behaviour in birds

Heron Island, Queensland, Australia
Thursday, 19 –Monday, 23 July, 2007

http://workshops.med.monash.edu.au/birdbehaviour07

Including Session on Avian Olfaction

NEWS

Announcement

The 2007-2008 ROSE MARIE PANGBORN SENSORY SCIENCE SCHOLARSHIP

One $14,000 Sensory Science Scholarship will be awarded for the 2007-2008 academic year to support a Ph.D. student who intends to teach and conduct research in the area of sensory science at the University level. This scholarship is awarded in honor of the memory of Professor Rose Marie Pangborn, who initiated the scholarship fund to encourage the education of Sensory Scientists intending to pursue academic careers.

Applicants for the scholarship must be enrolled in a Ph. D. Program such as Food Science, Nutrition, Psychology or Physiology. The planned or on-going dissertation research must be on a sensory topic under the guidance of a recognized sensory scientist. Candidates will be evaluated on the basis of their academic record, intended research in human sensory science, commitment to a career in teaching in the field of sensory science, and support determined by letters of recommendation. The Board of Directors of the Sensory Science Scholarship Fund (SSSF) will determine policies governing the award and will select recipients.

Applications, including all required documentation must be postmarked no later than July 1, 2007. For additional information and application forms contact Dr. Rick Mattes, Purdue University, Department of Foods and Nutrition, 700 W. State St., W. Lafayette, IN 47907-2059, USA Phone - 765-494-0662 FAX - 765-494-0674 email - mattes@purdue.edu Application forms are also downloadable at: http://www.cfs.purdue.edu/sssf/

Past recipients include: Martha Bajec, John Hayes, Derek Snyder, Cheryl Armstrong, Zuzana Drobna, Dr. Terri Rosett, Dr. Nicolette van der Klaauw, Dr. Sophie Bonnans, Dr. Jeanine Delwiche, Dr. Liz Gwartney, Dr. Thomas Heinbockel, Andrew Smith, Barbara Guggenbühl, Elba Cubero-Castillo, Randy Lee, and Lotika Bhatia Savant ■

News: South Africa: an opportunity goes begging

After due consideration the growing South African sensory community has decided it is not yet time to invite the international community to confer with them and enjoy the magic of Cape Town and surrounds. We hope they will come to our "icon location" meetings (probably at the Great Barrier Reef in December 2009) and see that they too have a similar great opportunity waiting to be taken up. Small communities of scientists (such as the Southern Hemisphere countries) either have to find the money to travel to international conferences or they have to find ways of bringing the internationals to them. The common pattern is to raise sponsorship and invite a select few "keynote speakers" from overseas. The "Heron" model is different and has proved very successful. At the 2002 and 2005 AACSS meetings at Heron Island on the Barrier Reef, all the overseas attendees paid for themselves, to come from Europe, Japan and USA. Our young academics and industrial people were exposed to a range of top people in their field, all in a glorious and friendly setting. We intend to do it again in 2009. The model could also apply to countries like Mexico, India and China, where spectacular "icon venues" (the kind of place everyone "must see before they die") can be used to motivate attendance. The *"fairest cape in all the world"* is perfect for this model. Its time will come. ■

AACSS at Novotel Barossa Valley

9th Scientific Meeting, Thursday 26th to Saturday 28th July 2007

Novotel Barossa Valley Resort, Rowland Flat, SA

The ninth scientific meeting of the Australasian Association for ChemoSensory Science will be held from the 26th to 28th July 2007. There will be a wine theme but the conference will cover the Society's usual broad range of chemosensory interests. (These dates are designed to dovetail with the 13th Wine Industry Technical Conference to be held in Adelaide starting 29th July).

Draft Program.

Thursday evening. Conference mixer 6-7pm. Plenary lecture 7-8 pm.

Friday. Morning and Afternoon Sessions. Evening: Conference Dinner.

Saturday. Morning session. Afternoon optional winery tour - at additional cost

Poster sessions will be held on Friday.

Conference and Accommodation

Conference Registration Fee is A$350 ($335 for students) - payable to AACSS by 31st May. This includes conference, morning and afternoon teas, Thursday evening mixer and Conference Dinner as well as membership of AACSS.

Accommodation

Delegates wishing to stay at the conference venue may choose to stay 1, 2 or 3 nights and should book accommodation directly with Novotel Barossa Valley. You will need to mention that you are with AACSS in order to access the conference rate. Twin share rooms are available for $181 per night and single share for $168 or $208 (with spa) per night. Rollaway or sofabeds can be arranged with the hotel for an additional $60 per person, per room per night. Room rates include fully-cooked breakfast. Accommodation is limited and any unbooked accommodation will be released in early June.

Details of the venue & contacts for booking accommodation:

http://www.novotelbarossa.com/
Tel: (08) 8524 0000 | Fax: (08) 8524 0100

Conference registration (see attached registration form):

Payable on or before 31st May.

Students:

If finances allow, a limited number of a limited number of post graduate (4th year and over) student subsidies will be offered by AACSS to students, to assist with fees and accommodation. Deadline for application is 31st May. If you are eligible, tick the box on the registration form.

Abstracts.

Abstracts are due on or before 31st May. Please send an electronic version to Stephen.Trowell@csiro.au using the attached template. Speakers will be selected by the Program Committee.

Australasian Association for ChemoSensory Science

9th Scientific Meeting **Registration & Payment**

Full name _____

e-mail address _____

telephone _____

Institution/company _____

Postal Address _____

Special dietary requirements? _____

Would you be interested in a transfer to/from Adelaide ❑ On Thursday evening? ❑ On Sunday morning?

Are you a graduate student? ❑

Would you be interested in a ½ day winery tour/tasting at ~$50? ❑

Payment details:

I enclose a cheque for (tick as appropriate):

$335 (students) ❑ $350 (all others) ❑

made payable to "Australasian Society for Chemosensory Science"

I have paid by direct deposit (tick as appropriate): $335 (students) ❑ $350 (all others) ❑

Reference (e.g. your initial and surname) _____

Receipt no _____

Bank: ANZ BSB: 013-332 Account No: 3502-86686.
Account name: "Australasian Association for Chemosensory Science".

Return to: Stephen Trowell
GPO Box 1700 Canberra ACT 2601

or e-mail form to Stephen.Trowell@csiro.au

Registration fees are not refundable.

Title: _____ Authors: _____

Affiliation: _____

Text (250 words maximum)

Indicate preferred format: ❑ Poster ❑ Platform Proposed session: _____

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Tom Tykwer's Movie Perfume and the World of Scents.

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Readers of this journal are doubtless familiar with many of the peculiarities of olfactory perception and its numerous ramifications into virtually all aspects of life, from anthropology to chemistry to neurology; from the social and historical to the individual and atmospheric; from odor abatement in industrial processes to fragrance creation and the art of perfumery; from the medical to the hedonistic, the gustatory and the erotic; and on into aromatherapy and the near mystical and transcendent. The following remarks touch on a few of the questions writers and film makers have to ask with this sensory mode and more broadly, how people in the humanities and the arts have grappled with the difficulty of representing smells, that evanescent realm of memory and imagination.

When the German author Patrick Süskind published his first novel, *Perfume (Das Parfum)* in 1985 he virtually reinvented the "good read" in German literature which, after a decade and a half of inferiority and autobiographical self-introspection had grown quite stale. *Perfume* made the German bestseller list for over eight years running and was translated into 42 languages (as of 2005). What would have been more natural than to follow up the book's success with a movie - especially as the plot is a good one?

Perfume is an imaginary historical novel set in eighteenth-century France. Its central character, Jean-Baptiste Grenouille, is a socially and psychologically marginal figure. As an abandoned child, he is slow to speak, but discovers early on his one great talent, the olfactory equivalent of divine power, including absolute olfactory memory and recall. Smells are his only interest and passion. His harsh upbringing includes work for a tanner in hideous and unhealthy conditions, but on occasional delivery errands he also gains a detailed olfactory map of Paris. Once, when ordered to take goat-hides for scenting to Baldini, a perfumer with a declining business and flagging creative powers, Grenouille seizes like a tick - a simile often invoked for him - his chance of getting out from the stench of tanning and into the fragrances of perfumery and thus coming closer to fulfilling his dream of one day creating the ultimate perfume that would inspire love in everyone. He knows what this would be, since he discovered it one night emanating from an adolescent girl in a little courtyard. He was attracted from afar by the barest scent trail escaping from her, and when he kills her and smells her empty, the principle of her scent orders his whole interior olfactory world. Thanks to Grenouille's indefatigable creativity, Baldini's perfumery, where he soon starts to work, gains European prominence, but after learning from Baldini as much as he can, Grenouille leaves Paris for Grasse, the capital of perfumery at the time, in order to broaden his techniques there.

The journey to Grasse takes seven years in the book (much less in the film), as it is interrupted by a solitary sojourn in one of the most remote and atmospherically pure areas of France. There, living primitively in a cave, Grenouille gives himself over to exquisite imaginative olfactory orgies until he discovers one day to his great horror that he himself is odorless. This discovery sends him on his way to Grasse, where he takes a job with a perfumer and finally acquires the knowledge of the more sophisticated techniques of scent production, enfleurage and maceration, makes his own experiments, and embarks on a series of murders of young virgins whom he kills for the sole purpose of obtaining their body odors - ingredients for his ultimate love-inspiring scent. Twenty-four victims already mark the murderer's trail, spreading fear and horror in the hearts of the whole population. Laure Richis, the daughter of the richest citizen in town, is the last. Her murder finally leads to Grenouille's arrest and death sentence. The execution, however, cannot be carried out because Grenouille, stepping out on the scaffold and wearing just a drop of his essence of woman, inspires such love, desire, and concupiscence in the thousands of spectators that the planned beheading degenerates into a mass orgy. This is Grenouille's moment of supreme power - and of disgust at the easy olfactory gullibility of ordinary humans. He leaves Grasse and heads back to Paris, where he sprinkles the rest of his perfume all over him and has himself killed and cannibalized by a group of criminals in a kind of suicide by proxy.

All the ingredients of a good movie script are here: a murder plot, occasion to show some pretty, young women - alive, dead, and naked - a weird sense of erotics, the novelty of a sensory mode not often explored in the arts, and a historical, slightly exotic setting.

But Süskind, somewhat of a reclusive author, not unlike Pynchon, needed twenty years of persuasion until he agreed to the movie: *Perfume*, the film, directed by Tom Tykwer (of *Run, Lola, Run* fame, 1998), was relseased in Europe in September of 2006 after a couple of years of media hype, and

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in the USA in December of that year. It triggered its share of internet sites and Thierry Mugler created a collection of perfumes in an elegant *coffret*, available on line. The film played successfully in Europe without, however, becoming an outright blockbuster, but it hardly registered in the USA at all outside of circles already interested in the esoteric realm of olfactory perception.

For those interested in olfaction *culturally* it poses different challenges than it does for those interested in olfaction primarily *scientifically*. Both inquiries, however, require truly interdisciplinary approaches. Are there perhaps plausible reasons, intrinsic to the sense of smell, that prevented a wider success of the film? Or, to put the question differently, what are the peculiarities of olfactory perception and the possible obstacles to creating an olfactory-centered visual artwork with broad mass appeal? Is there anything that makes this sensory mode more difficult or more problematic than other senses when it comes to representing it in film?

A number of things come to mind: for one, there are really only two kinds of odors in the world: the good and the bad. While this distinction is clear and visceral, it is much harder to be precise or intelligent about everything in between; "good" or "bad" is often all we have to say about a given smell. We are just not very good at talking about smells. Both the book and the film make a lot of this sharp distinction along which the world literally breaks into two halves: an attractive and desirable - and a disgusting and dangerous one.

Our difficulty in putting smells into words has to do with three interlinked areas: neurology, linguistics, and problems of taxonomy and categorization on which all finer distinctions rest.

Olfactory taxonomies have been one of the oldest and most persistent scholarly and scientific concerns, testifying to the difficulties in ordering and structuring the realm of smells. Hans Henning's smell prism from the early years of the twentieth century is an example. It offers a spatial representation of smells, grouping them in a triangular prism with six primary odors. These include fragrant, putrid, ethereal, burned, resinous and spicy as its categories. Another classification is the Crocker-Henderson system. It has only four classes of odor: burned, fragrant, acid, and caprylic. Even earlier the Dutch physiologist, Hendrik Zwaardemaker had given the problem some thought too; and more recently Anne Noble and her team at the University of California-Davis developed a wine aroma wheel, i.e., a circular model of (enological) categories which has since been adapted to classify other aspects of the chemical senses. This helps, of course, but for olfactory perception it still does not address the fundamental paucity of its linguistic terminology. Dan Sperber, Director of research at the CRNS in Paris, in *Rethinking Symbolism* (Cambridge UP, 1975, 115-16) notes that

> Even though the human sense of smell can distinguish hundreds of smells and in this regard is comparable to sight or hearing, in none of the worlds' languages does there seem to be a classification of smells comparable, for example, to colour classification. Ethno-linguists systematically describe colour classifications, often containing several hundred terms ordered under a small number of basic categories. ... We would search in vain for a similar work on smells; perhaps this is a sign of lack of imagination on the part of scholars, but more likely it is because there is nothing for such a work to be about. ... There is no semantic field of smells. The notion of smells only has as lexical sub-categories general terms such as 'stench' and 'perfume.' Our knowledge about different smells figures in the encyclopedia not in an autonomous domain, but scattered among all the categories whose referents have olfactive qualities.

In the absence of a lexical category where we would find "smells" - as we find "colors" or "geometric shapes" or "trees" and apart from a few adjectives (that are often borrowed from other sensory modes - the *sweet* smell of success, the *pungent* aroma of, say, a cheese, the acrid stench of a factory process - we always refer to the source of an odor sensation: "the smell of ..."; "it smells like ..." when we talk about smells. Using adjectives instead - a "flowery" perfume," "a spicy note," "an aldehydic perfume" - does not change anything in this fundamental referential system: we are simply unable to escape the chaos of the vast world of objects (legions of which have olfactive qualities) for a more orderly world of linguistic categories and referents. This embarrassment of ours is aggravated by the fact that western societies by and large have not found it necessary to instruct their members on the sense of smell. (That there exist groups, however, that integrate olfactory perception culturally and with more social structuring power than we do, is discussed by Constance Classen et al., *in Aroma: The Cultural History of Smell*, 1994. She is one of the leading anthropologists who emphasize olfactory perception). There are music lessons at school; there is art and photography and film; there is sports and

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dance and massage and other legitimate fields of the tactile. And even the sense of taste, in its high valuation in *haute cuisine*, fine dining and drinking and the very creative and artistic vocabulary of food and wine writing has its dimension of teaching and learning and the arts. And it has at least four broadly recognized basic qualities: sweet, sour, bitter, and salty. Olfactory perception only has two: good and bad - the latter to be avoided if at all possible. Nevertheless, this simple dichotomy has given rise to two "industries," broadly speaking: of deodorization and of perfumery, and the latter has achieved the status almost of an art, certainly of artifice and has one crucial aspect in common with the culinary: its creations are consumed and disappear in the very act of their appreciation.

But before briefly discussing deodorization and perfumery, let us focus on a few salient neurological aspects underpinning this state of affairs, the functioning of the nose itself, and the peculiar anchoring of the sense of smell in the brain. I do not want to enter this territory in any depth, as many of my readers are more familiar with this side of olfactory perception than I am. But there is the peculiar wiring of the olfactory apparatus in the brain through the olfactory bulb, the strong neural connection to the limbic system and thus emotions and memory that is generally associated with smell. As one of the two main chemical senses, olfactory perception also is strongly correlated to the affect of disgust that is more easily triggered through the lack of distance between the perceiver and the object of perception, the danger of contact, contamination, and contagion that characterizes olfaction and gustation. And there is the always intriguing but equally contested role of olfaction in sexual attraction, the potential of human pheromones and how to harness them. And although Linda Buck and Richard Axel in their Nobel-Prize-winning work (2004) made great strides in explaining the fundamental workings of the nose, there are still several models in operation, specifically the two that Luca Turin, himself a famous nose, biophysicist, and olfactory chemist has termed the "shapist" and the "vibrationist" model of nasal molecular-synaptic interaction - with himself firmly in the second camp. Be all this as it may: it remains in the background of the present discussion - to which Turin's remarkable, Parfums, Le Guide (on line, in French at <http://www.flexitral.com/research/Guide%201994.pdf> and Chandler Burr's biographical account of Turin's life and work, *The Emperor of Scent: A True Story of Perfume and Obsession* are more pertinent - because they deal with perfume.

Perfumery and perfumes have a long history, and trade in perfume raw materials has left historical trails since biblical times and even before. Humans took pleasure in good-smelling things from earliest times and they most often linked them to the spiritual and the erotic; the "Song of Songs" in the Old Testament provides rich references to both. On the other hand, humans were also fully aware of the unpleasant end of the olfactory spectrum that came to be so feared in the enlightenment of the eighteenth century and the culture of enlightenment and rational, critical inquiry that has underpinned our (western) secular world ever since to the point that the grand human project of enlightenment itself and progress can justifiably also be called a process of deodorization of both the human body and its public spheres, counterbalanced by their re-odorization with approved new good scents. In this historical long view, olfactory standards have changed and we live today in a different world from the one Süskind evokes. But we also still live in cultures each with its individual olfactory aura, from the near odor-free world of American consumerism, to the more pungent world of French cheeses, and the reek of the slums of the large cities of the "Third world."

The stark division of the realm of smells has remained a key point of fascination both in real life and in Süskind's book and the movie: on the one hand the world of perfumery, of the deliberate creation of good scents, the aesthetic luxury products of rich and sophisticated societies - on the other the world of the often inescapable malodors of life, the stench of offal, cadavres, the miasmas of the swamps and cemeteries and the very streets and alleys, cramped and crowded and filled with the reek of rot and excrement! All this had become at the very time and place where Süskind set his plot - French enlightenment, the eighteenth-century, the city of Paris - an area of public interest and scholarly investigation. Alain Corbin's acclaimed book, *The Foul and the Fragrant* (1982 in French; 1986, Harvard UP in English) describes this growing historical concern with public malodor just in time for Süskind, who speaks French and lived in Paris at the time, to have studied it as a rich source for the well-researched historical context of his novel. It is to a large extent this contrast on which the novel thrives and from which it derives its *frisson*, which creates the dark fascination for the reader. In *Perfume* Süskind created for the first time a fictional representation that was both sensory and sensual of that dichotomous world - and

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continued

pursued it via a hitherto largely neglected sensory mode. (There were some leads, though: Eugene Rimmel, for instance, the nineteenth-century French perfumer whose business, now London-based, still survives, at least in name, may have provided a historical model for Baldini - and had written interestingly on the perfume business himself; and Roald Dahl, in his short story "Bitch" (1974, in a collection of short stories titled *Switch Bitch*, still available in paperback) had provided a brief, sexed-up plot model that Süskind possibly drew on). He did this through a brilliant postmodern pastiche, full of allusions and references to other texts, historical dates, and linguistic imitations, relying on thick description, drawing on solid research and his superb imagination - all married to a plot that was simply a page turner. In other words: Süskind succeeded in literature, in language, to capture the essence of olfactory perception!

How did he do it? - Imagination, thick description, intertextuality are the writerly devices he used. These devices not only accommodate but require and build on a key quality of olfactory perception in language - a quality feared by some writers in some contexts and loved and extolled by others: the inevitable break of the surface structure of a text when smells are invoked in the reference to their origin. Süskind's description of Paris begins thus:

> In the period of which we speak, there reigned in the cities a stench barely conceivable to us modern men and women. The streets stank of manure, the courtyards of urine, the stairwells stank of moldering wood and rat droppings, the kitchens of spoiled cabbage and mutton fat; the unaired parlors stank of stale dust, the bedrooms of greasy sheets, damp featherbeds, and the pungent sweet aroma of chamber pots. The stench of sulfur rose from the chimneys, the stench of caustic lyes from the tanneries, and from the slaughterhouses came the stench of congealed blood.

The sense of smell is an environmental sense, transgressive and, through its biology, enveloping, contagious, and unavoidable. Olfactory references thus lead out of the more controlled realm of visual description, say, of circumscribed social classes, or coded verbal exchanges among characters directly into the wilderness of the object world. And in Süskind this is more often than not an unpleasant and disgusting world. He draws on the fact that olfactory perception is more connotative than denotative, more allusive than directed, more implicit than explicit - and thus leaves the reader with more leeway for imagination than visual description does, which takes the reader on a much shorter leash than the olfactory.

And yet, of course, novels as texts, novels per se do not smell! But they also do not sound, nor do they include images or tastes - except through the evocative power of language itself, the magic of the black letters on the white page that our imagination turns into an experience of sorts - mostly, one suspects, through visualization: the mind has an eye, as we say - but it is not entirely clear where its nose is. Tykwer, the director, makes a valid point in an interview, on line at <http://www.twitchfilm.net/archives/008277.html>: some people had warned him of the difficulty in converting olfaction into images, as it were. But what is the difference, he countered: it is already converted, namely into language. He is right: any form of cultural recording is a kind of dehydration of sensory experience that needs to be reconstituted in the act of consumption, be it in reading, in viewing, in interpreting and discussing of the record and regardless of whether the record is of actual events or imagined ones to begin with. Olfaction is different only insofar as it tends to ramify more, is perhaps less predictable, more individual but also more contextual in its invocation of whole situations rather than single elements: it is the synaesthetic sense par excellence, drawing on and invoking in memory, contexts in addition to specifics, a whole scene into which its individual parts are integrated; it is the sensory mode that both draws on and feeds the imagination in myriad ways. J.K. Huysmans in *Against the Grain* (1884 in French) provides rich examples of the representative translations of one sensory mode into another; in Aldous Huxley's *Brave New World*, his famous dystopian novel from 1932, people go no longer to the movies but to the sensorially more comprehensive *"feelies"* where a "scent organ" plays, for instance, "an herbal capriccio." What Tykwer had to provide, therefore, was a new "translation" from Süskind's astoundingly rich and evocative verbal representation of a smell-centered world into the language of *images.* All cultural production, in any art form, is a kind of translation from an *ur*-text that we don't have: the original experience - real, historical, or imagined. It is on this translation that the film ought to be judged.

I think Tykwer did a remarkable job. But after the book's success the bar had been placed high for the film. In plot, the film follows the book quite faithfully; in its philosophical implications that Süskind creates via a rich intertext and in additional episodes that the movie leaves out, the film is thinner - not an uncommon phenomenon in turning literature into cinema. But the key criterion is the recreation of the atmospherics of the book, the ambiance, the starkly binary world of stenches and

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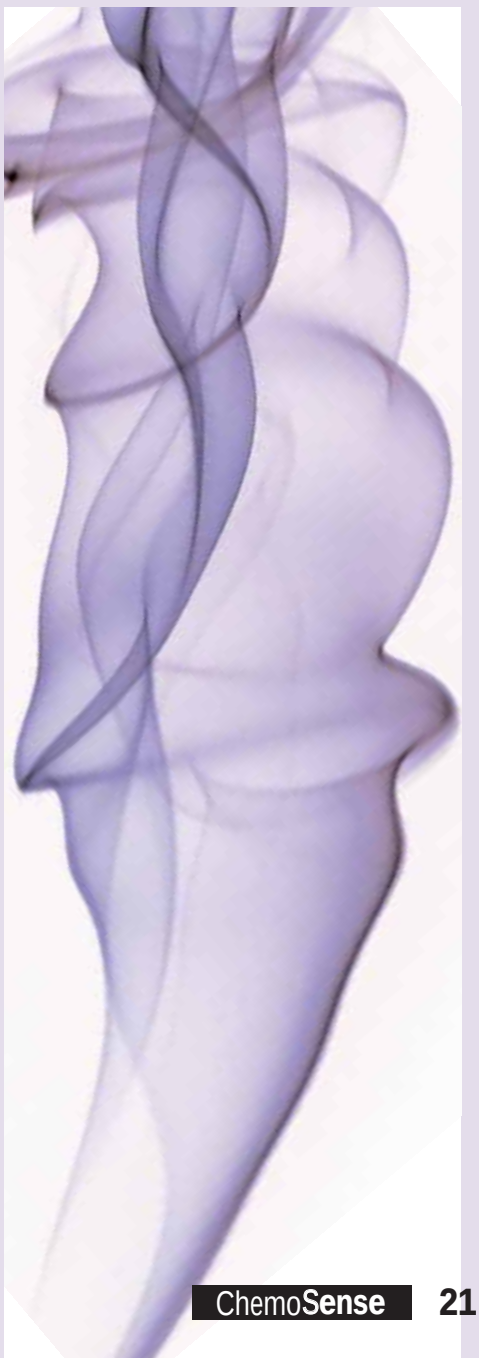
continued

fragrances. In this the movie has, if anything, an advantage over the text, at least in certain scenes, such as the crucial encounter between Grenouille and that girl with the basket of plums, his first victim, through whom his thus far still muddled olfactory inner universe falls into place and order. The impact of this key scene rests on its playing on the common notion that we fall in love at first sight - and not at a first whiff. Well, Grenouille does the latter - but Tykwer also makes it clear that there is no love on Grenouille's part: he is incapable of that human feeling; the erotics of that scene - and there *is* erotics - is stark, brutal, and murderous but entirely asexual. Time and again, Tykwer uses this scene in flashbacks as a shorthand for "explaining" what makes Grenouille tick. But the movie, especially in the early scenes on the grimy market in Paris, where Grenouille is born under a fish stall and left to die among the offal, is also brilliant in invoking directly and with nauseating immediacy that world of dirt, slime, disgust, and danger that the text creates through exhausting enumerations, such as the one quoted above. The rapid cut, cut, cut from one grimy, yucky object - fish heads, rotting produce, greasy clothes, dirty hands, sweaty faces - often close up and cropped to take them out of context and deprive the viewer of the safety of distance, works at least as well as the lists and descriptions in the text. Another device Tykwer uses effectively is lighting or, more often, the absence of it. The film overall is rather dark, generally a reddish, warm darkness. Objects, people, faces merge with it, fade out, lose their clear boundaries; the images thus are not firmly framed but dissolve around the edges and create their impact through connotation and association rather than through clear denotation and categorization. Viewers are forced to extrapolate and fill in, to contextualize and complete. Objects, such as the flaring nose surrounded by darkness, without even the face to which it belongs, that opens the film, appear decontextualized, monstrous - and it falls to the reader to "make sense." The pervasive use of that warm half-shadow also lends objects a heightened sensuousness as the camera seems to caress them, especially the women, notably Laure, Grenouille's last victim. In contrast, the scene where her father detects her dead body is over-exposed and fades to complete white in an effort to show his horror, pain, and sense of loss: his mind goes literally blank. Lighting, then, and color and tint are the atmospheric devices Tykwer uses; rapid cuts and juxtapositions imitate Süskind's lists of olfactory objects and both decontextualize *and* demand contextualization, thereby offering a visual-narrative *ersatz* for the intrinsically contextualizing nature of olfactory perception itself. The film played more successfully in Europe, I believe, because of broad underlying cultural parameters. First, it *is* set in Europe and is historically and geographically specific; second, the French have a reputation for sensuousness - even its aspects that Americans, this the third point, find less appealing from the perspective of their own cultural values that unambiguously privilege cleanliness and odorlessness. And finally there is a certain weirdness, creepiness both in the book and the movie that derive from an intimacy, an ongoing invasion of personal space that is not sexual (in which case it would be at least understandable, even if not necessarily welcome) but aims at something different - scent, odor, the body along its margins. I think it is this darker side of enlightenment that Europeans have a greater sense for or are, perhaps, simply more resigned to live with than Americans. The movie is thus well worth seeing, even if not an outright masterpiece. But as so often with literature turned into cinema: for the more philosophical implications, the book is still indispensable.



Upcoming Events

7-9 June, 2007	**"Bacchus at Brock"** International Interdisciplinary Wine Conference St Catherines, Ontario Canada Info: www.brocku.ca/bacchus
9-11 July, 2007	**39th Annual AIFST Convention** Adelaide Convention Centre Adelaide South Australia Info: aifst@aifst.asn.au or www.aifst.asn.au
26-28 July 2007	**AACSS: 9th Annual Meeting** Adelaide, South Australia Contact: Stephen.Trowell@csiro.au
12-17 July 2007	**IBRO** (International Brain Research Organisation) Melbourne, Australia Contact: http://www.ibro2007.org
19-23 July 2007	**Avian Olfaction Symposium** IBRO Satellite on Avian Brain, Cognition and Behaviour Heron Island, Queensland, Australia Info: http://workshops.med.monash.edu.au/birdbehaviour07
28 July - 2 August 2007	**The 13th Australian Wine Industry Technology Conference** Adelaide, South Australia Contact Rae Blair: rae.blair@awitc.com.au
12-16 August 2007	**7th Pangborn Sensory Science Symposium** Hyatt Regency, Minneapolis, USA Abstract deadline: 31 January, 2007 Info: www.pangborn2007.com
6-8 May 2008	**Enviro 08** Melbourne Info: rvquitz@bigpond.com
21-25 July 2008	**International Symposium on Olfaction and Taste (ISOT)** San Francisco, USA Now calling for proposals for satellite meetings Contact Tom Finger: tom.finger@uchsc.edu ■

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