BRAINWASHED BY WINE TASTERS?

Wine tasting has more to do with the individual taster than it does with the wines being tasted. So argues **Dr Jamie Goode** in a report that questions the value of any tasting notes you've ever read

Uncork a good bottle, pour yourself a glass and then take a sip. We call this process wine 'tasting', but this is actually a fairly misleading term. In this interaction between you and the wine, the impression you form is a conscious experience that involves the fusion of inputs from at least four different senses, coupled with some sophisticated brain processing. It's a unified representation that can't easily be dissected into its component sensory inputs, which is what we commonly try to do with taste and smell. The goal of this feature is to take an in-depth look at the role of the brain during the wine-tasting process. I'll be addressing some complicated questions across the disciplinary boundaries of neuroscience, psychology and philosophy. While many of these issues are as yet unanswered or have only partial answers, what we already know of how the brain processes flavour suggests that we should revise the way we approach wine tasting.

Most controversially, I'm going to argue that the way rating or scoring wine is currently practised is based on a false premise: that when a critic rates a wine, they are assessing the wine, and that any score thus produced is a property of this wine. This is incorrect. We need to make the subtle yet important paradigm shift of seeing a critic's assessment as a rating of that critic's perception of the wine. To put this another way, the critic is actually describing a conscious representation of their interaction with the wine, and therefore the score or rating is a property of that interaction and not of the wine itself. My goal here, therefore, is to explore the nature of that representation, how it is constructed in the brain and how this might lead to differences among individuals' perceptions of the same wine.

Two caveats. First, while I'm sure most readers of this magazine have a high level of education, not all will be scientifically literate, so I'll try to make the science here accessible. Second, I'm dealing with several complex branches of science, some of which lie outside my own realm of expertise. I'll try my best to get it right, but if I fail, do let me know (e-mail jamie@wineanorak.com). I also need to add a word on terminology. Although the term 'wine tasting' is technically inaccurate for reasons already explained, I'm going to continue using it simply because there isn't a better description for the practice of assessing and comparing wines. And while 'smell' stands largely as a sense on its own (you can smell a wine without tasting it, although there will be some visual input), taste doesn't: you can't taste a wine without smelling it. Much of the sensory information when wine is in our mouths comes from the senses of olfaction and touch, which can't therefore be dissociated from the sensations coming from the taste buds. Thus I prefer to use the term 'flavour' to describe this multiple sensing of wine in the mouth that results in a seamless, unified perception of wine.

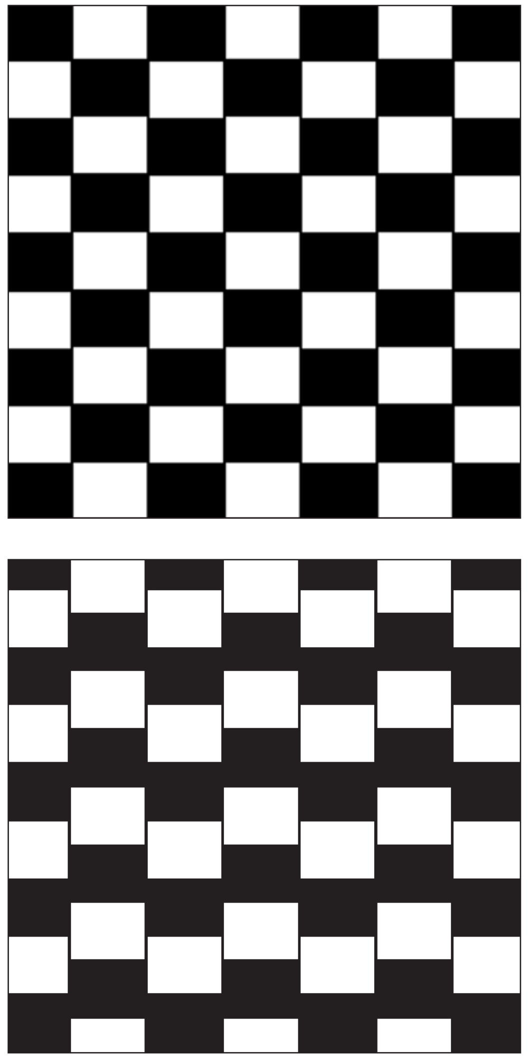
Introducing the chemical senses

Any readers who have ever walked a dog will be aware that for Fido or Rover the world of smell is as important and dynamic as the visual world. In contrast, we humans live in a vastly diminished smell world, having traded our olfactory acuity for enhanced colour vision – an evolutionary change that took place some time during primate evolution. Rather than being important for orientation, social organisation and mate choice, as it is for many mammals, our use of the chemical senses taste and smell is largely restricted to food choice – a reduced but still vital role.

Taste and smell begin with receptors in the mouth and nasal cavity that turn chemical information into electrical signals that can then be processed by the brain. The tongue and soft palate have taste buds containing receptors for five modes of chemical stimuli: sweet, salty, bitter, sour and umami. The nasal cavity contains olfactory receptor neurons that express, among them, around 2,000 different receptors, each tuned to recognise different chemical signatures of volatile odorants.

But it's wrong to think of our sensory systems as complicated measuring instruments that give a read-out of the taste and aroma molecules that they encounter. That wine perception is a result of a combination of such linear inputs is a common misconception. This simplistic view of taste and smell leads to a range of misunderstandings and apparent anomalies when it comes to wine tasting.

Instead, what the brain does is model the world around us. Our sensory systems are bombarded constantly by a mass of information that, if attended to uniformly, would swamp our perceptive and decision-making processes. So the brain is able to extract from this sea of data just those features that are most relevant. This is done by a procedure known as higher-order processing.



The café-wall illusion is created by moving the rows of the grid to offset them slightly. Although the vertical lines are still parallel, this isn't what our visual systems are telling us.

Let's look at this another way. We often think that our sensory system is revealing to us the world around us in an accurate and complete way. But what we actually experience is an edited version of reality based on the information that is most relevant to our survival and functioning. For almost all purposes it does no harm for us to think of the world as revealed to us as 'reality' – indeed, life would become quite complicated if we operated any other way. But for the purposes of this discussion, it's useful to realise that the version of reality we experience is an edited and partial one.

This can be illustrated in a number of ways. Think again about your household pets, if you have any. As I mentioned earlier, dogs live in a smell world that is almost completely closed to us but is just as vivid to them as the visual world is to us. Rats and mice, like many small mammals, get almost all the information they need about their environment from a combination of sniffing and using their whiskers – they are nocturnal, and vision isn't so useful at night. Now switch on your radio or television, or take a call on your mobile phone: it's clear that the air is full of information that we can't access unless we have a device to decode it. Third, take a look at the visual illusion known as the café-wall illusion. It's just one of many tricks that 'fool' the visual system. These sorts of illusion give us clues about the sort of higher-order processing that is taking place, and they demonstrate that what we 'see' is not always what is there.

The higher-order processing in the visual system is the best understood of all the senses. Scientists have worked out how visual processing extracts features of the environment that are most likely to be relevant. For instance, our peripheral vision is sensitive to motion: moving objects immediately stand out because neurons are tuned to respond to them. This motion-detection ability is much stronger in the periphery than it is in the central visual field. Look at your computer monitor (as long as it is a conventional tube and not a flat screen), and then look away. As you look away, the screen of your monitor appears to flicker in your peripheral vision; you weren't aware of this while you were staring at it. Faces are also likely to be significant cues, so our visual systems have special brain mechanisms for face processing. This is the reason why so many advertisements and magazine covers rely on human faces, even where the face isn't particularly relevant.

Although it is less well studied, this sort of higher-order processing is also important in flavour detection. We are bombarded with chemical stimuli all the time, and the brain has to filter this information so that only the important bits get through. It seems that much of the brain is dedicated to producing a suitably edited view of reality, just as the staff in a newsroom work hard all day sifting through the output of their journalists to produce a 15-minute news bulletin for broadcast that evening.

Gathering data

So we come to the key question: how is it that electrical currents from nerve cells are translated into a unified conscious experience in the brain? Science is a long way from being able to address this complex question directly. But a relatively new technique, functional magnetic resonance imaging (fMRI), has transformed brain research in recent years by allowing researchers to visualise the brain in action. During an MRI scan, a subject is placed inside a large cylindrical magnet and exposed to a massive magnetic field. A sophisticated detection device then creates three-dimensional images of tissues and organs from the signals produced. fMRI is a twist on this theme, where the technique is used specifically to measure changes of blood flow in the brain. When a group of brain cells becomes more active, they need more blood, and this generates a signal in the scan. Although there was initially some controversy about whether a direct correlation exists between the blood flow detected in an fMRI scan and actual brain activity, the consensus in the field is that this is indeed the case. The power of fMRI is that it can show how we use our brains when, for example, we think of chocolate or move our middle finger; the limitation is that, in order to detect these signals reliably, subjects are required to lie inside a large metal cylinder with their heads completely still.

Because of the practical and experimental difficulty of these sorts of study, it's an area in which there is still a lot of uncertainty. However, even the limited data obtained so far are highly relevant for wine tasting, and they are important if we want to provide a robust theoretical basis for the human interaction with wine.

Let's pick up on the theme of flavour processing in the brain. The senses of taste and smell work together to perform two important tasks: identifying nutritious foods and drinks, and protecting us from eating things that are bad for us. The brain achieves this by linking food that we need with a reward stimulus – it smells or tastes 'good' – and making bad or unneeded foods aversive. To do this, flavour perception needs to be connected with the processing of memory (we remember the foods that are good as well as those that have made us ill) and emotions (we have a strong desire for food when we are hungry, and that motivates us to seek out a decent meal). Because seeking food is a potentially costly and bothersome process, we need a strong incentive to do it. Hunger and appetite are thus powerful physical drives. They are also finely tuned. It is striking that we are able to eat what we need and not a lot more or less: even a slight imbalance, over decades, would result in gross obesity or starvation.

Taste begins on the tongue, where we have some 5,000 specialised structures called taste buds embedded within lumps called papillae. Each taste bud contains 50–100 sensory cells responding to one of the five different primary tastes. These sensory cells convert this chemical information into electrical signals that then pass through to the primary taste cortex in the brain. This is located in a region called the insula. Taste provides us with relatively little information compared with the sense of smell, more commonly referred to in scientific texts as 'olfaction'. Whereas there are just five basic tastes, we can discriminate among many thousands of volatile compounds ('odorants'). Our olfactory epithelium, located in the top of the nasal cavity, contains olfactory receptor cells, each of which expresses just one type of olfactory receptor. This information is also turned into electrical signals by these receptor cells and is then conveyed to the olfactory cortex via a structure known as the olfactory bulb.

At this stage, with the information that exists at the level of the primary taste and smell areas of the brain, it is likely that all that is coded is the identity and intensity of the stimulus. Alone, this information is of relatively little value. But what the brain does next is this clever higher-order processing mentioned earlier: it extracts the useful information from this mass of data and begins to make sense of it. This is where we turn to the work of Edmund Rolls, a professor of experimental psychology at the University of Oxford, who has studied a region of the brain called the orbitofrontal cortex. fMRI is one of the tools used in his work.

The work of Rolls and others has shown that it is in the orbitofrontal cortex that taste and smell are brought together to form the sensation of flavour. Information from other senses, such as touch and vision, is also combined at this level to create a complex, unified sensation that is then localised to the mouth by the sense of touch – after all, this is where any response to the food or drink, such as swallowing it or spitting it out, will need to take place. Rolls has also demonstrated that the orbitofrontal cortex is where the reward value (the 'niceness', known more grandly as 'hedonic valence') of taste and smell is represented. That's another way of saying that this is where the brain decides whether what we have in our mouths is delicious, dull or disgusting. Another fMRI study has shown that the brain uses two dimensions to analyse smells, intensity and hedonic valence. The amygdala responds to intensity, while the orbitofrontal cortex is the region that decides whether the smell is good or bad.

Cross-modal processing

Some nerve cells in this brain region respond to combinations of senses – such as taste and sight, or taste and touch, or smell and sight. This convergence of inputs, known as cross-modal processing, is acquired by learning, but it is a process that occurs slowly, typically requiring many pairings of the different sensations before it is fixed. This suggests an explanation for why we often need several experiences with a new food or wine to be able to appreciate it fully. It is also at this level that stimulus-reinforcement association learning takes place. This is the situation where, for example, you are faced with a new food (stimulus) that tastes good, but then it makes you violently sick (association). Next time you pop some of this in your mouth, you immediately spit it out in disgust. It saves you the bother of being sick again and is therefore a protective mechanism.

Sensory-specific satiety

One aspect of Rolls's research on the orbitofrontal cortex that has direct relevance to wine tasting is his work on sensory-specific satiety. This is the observation that when enough of a particular food is eaten, its reward value decreases. However, this decrease in pleasantness is greater than for other foods. Putting it more simply, if you like both bananas and chocolate, and eat a lot of bananas, you can't stomach the thought of another banana but you might still fancy a little chocolate. This clever brain trick makes us desire the particular sorts of food that we need at a given time and helps us to balance our nutritional intake. By fMRI, Rolls has shown that in humans there is a decreased response in the orbitofrontal cortex to the odour of a food eaten to satiety, but the response to another odour that has not been eaten does not change. The subject's perception of the intensity of the smell of the consumed food doesn't change, but his perception of its pleasantness (hedonic valence) does. In another study, Rolls showed that swallowing is not necessary for sensory-specific satiety to occur. When I quizzed him about this, Rolls was cautious about speculating (as many scientists rightly are) but agreed that this could have some effect during a wine tasting, where a taster is repeatedly encountering the same sort of taste or smell. At a large trade tasting it is quite common to taste as many as 100 wines in a session. If these results of sensory-specific satiety are extrapolated to this sort of setting, then it's likely that the brain will be processing the last wine you taste differently to the way it processed the first, assuming that there are some components to the taste or smell in common – for example, tannins, fruit or oak.

This all makes perfect sense at a practical level. When you haven't eaten for a long time, even simple foods can taste great: their hedonic valence has been altered by your state of hunger. I love raspberries, but they would lose their appeal if I had already eaten five punnets of them. I'd still recognise them as raspberries, though. My brain is changing how attractive I find various flavours according to other information it is receiving.

Trained tasters experience wine differently

In 2002, researchers from the Functional Neuroimaging Laboratory of the Santa Lucia Foundation in Rome, headed by Dr Alessandro Castriota Scanderberg, put together a simple yet elegant study addressing a key question: do trained tasters experience wine differently from novices?

They took seven professional sommeliers and seven other people matched for age and sex but without specific wine-tasting abilities, and they monitored their brain responses while they tasted wine. But getting someone to taste wine while they are having their brain scanned is no trivial feat. 'The experience was pretty uncomfortable,' recalls Andrea Sturniolo, one of the sommeliers involved. 'I was under a tunnel with four plastic tubes in my mouth, totally immobile.' Through these tubes the researchers fed subjects with a series of four liquids: three different wines and a glucose solution as a control. Subjects were told to try to identify the wines and form some sort of critical judgment on them. They were also asked to judge when the perception of the wine was strongest: while it was in the mouth ('taste') or immediately after swallowing ('aftertaste'). 'The experiment lasted a good 50 minutes,' says Sturniolo, 'which seemed endless.' He added, 'Certainly they were not the ideal conditions to carry out such a delicate experiment, but since the conditions were identical for all participants, I think the results are reliable.'

So what did the scans show? Some brain regions – notably the primary and secondary taste areas, in the insula and orbitofrontal cortex – were activated in both sets of subjects during the 'taste' phase. But during this initial period, another area was activated only in the sommeliers, and this was the front bit of a region known as the amygdala–hippocampal area. In the 'aftertaste' phase, the untrained subjects also showed activation of this amygdala–hippocampal area, but only on the right side, whereas in the sommeliers this zone was activated on both sides. In addition, during the aftertaste the sommeliers exclusively showed further activation in the left dorsolateral prefrontal cortex.

Not surprisingly, given its importance in the processing of flavour, the orbitofrontal cortex is one of the regions activated in the brains of both trained and untrained wine tasters in this study. What about the other areas, the ones that were highlighted specifically in the sommeliers?

First we have the amygdala–hippocampal area. This is a zone that plays a key role in processing motivation (the amygdala) and memory (the hippocampus). According to study leader Dr Scanderberg, 'The finding of an early and consistent activation of the amygdala–hippocampus complex in the sommelier group suggests a greater motivation for the recognition process.' This may indicate that the sommeliers were expecting a reward and thus pleasure from the wine-tasting process. The other key area is the left dorsolateral prefrontal cortex, which is a zone involved in the planning and use of cognitive (thinking) strategies. The sommeliers' unique activation here is consistent with the idea that only experienced tasters follow specific analytical strategies when wine is in their mouths. The researchers speculate that these strategies might be of a linguistic kind, associating words with specific flavours. We'll return to this important concept later.

In parallel with fMRI studies on musicians that have shown that music activates different areas of trained musicians' brains from those of casual listeners, it seems that the sommeliers are experiencing something different to the average person when they taste wine. 'There is clear evidence that the neural connections of the brain change with training and experience,' says Dr Scanderberg. He explains that 'there are two apparently contradictory ways that the brain adjusts its structural network in parallel with the increasing expertise of the subject'. The first, and most common, is to assign a specific function to a smaller cluster of cells higher up in the brain's hierarchy. For example, during rehabilitation of stroke patients, it is common to see a particular task activate a much smaller but higher-up region in the brain at the end of rehab than it did at the beginning. The second strategy is to recruit more brain areas to help with a complex task. Experienced wine tasters seem to follow this second strategy, pulling in new brain areas to help with the analysis of sensory stimuli.

Experienced wine tasters seem to pull in new brain areas to help with the analysis of sensory stimuli

The implications for wine tasting are clear. I'm assuming here that, as a reader of this magazine, you may well be someone who has drunk a fair bit of wine over a number of years. Do you remember one of the wines that first really appealed to you? If you were to go back in time now and taste that wine again, but with your current wine drinking history, then you'd actually perceive something quite different as you sipped that wine the second time around. Your brain has been changed by drinking all that wine, and we aren't talking alcohol-induced neural degeneration. By paying attention as you've been drinking, just like the sommeliers in this study, your response to wine differs from that of untrained subjects. This also underlines the importance of the learning component in wine appreciation. People versed in one culture of wine may need to re-learn about wine when exploring another. Even if you have years of expertise in Australian reds, for example, you may have to start from scratch when trying to appreciate German Riesling.

Frédéric Brochet uses the results of his theory of perceptive expectation to explain Peynaud's observation that 'blind tasting of great wines is often disappointing'

Words and wine: how we form representations of the tasting experience

Moving fields slightly, Frédéric Brochet, a cognitive psychologist, has done some important work that is highly relevant here. He has studied the practice of wine tasting as carried out by professionals. His claim is that the practice and teaching of tasting rests on a fragile theoretical basis. 'Tasting is representing,' says Brochet, 'and when the brain carries out a "knowledge" or "understanding" task, it manipulates representations.' In this context, a 'representation' is a conscious experience constructed by the mind on the basis of a physical experience – in this case, the taste, smell, sight and mouthfeel of a wine. Brochet uses three methodologies in his work: textual analysis (which looks at the sort of words that tasters use to verbalise their representations), behaviour analysis (inferring cognitive mechanisms from looking at how subjects act) and cerebral-function analysis (looking at how the brain responds to wine directly through the use of fMRI).

Textual analysis: studying the words that tasters use

Textual analysis involves the statistical study of the words used in a text. Brochet used five data sets, consisting of tasting notes from Guide Hachette, Robert Parker, Jacques Dupont, Brochet himself and notes on eight wines from 44 professionals collected at Vinexpo. Employing textual analysis software called ALCESTE, Brochet studied the way that the different tasters used words to describe their tasting experiences. He summarises his six key results as follows:

1. The authors' descriptive representations are based on the types of wine and not on the different parts of the tasting.
2. The representations are 'prototypical' – that is, specific vocabularies are used to describe types of wines, and each vocabulary represents a type of wine. Putting this another way, when a taster experiences a particular wine, the words they use to describe it are those that they link to this sort (or type) of wine.
3. The range of words used (lexical fields) are different for each author.
4. Tasters possess a specific vocabulary for preferred and non-preferred wines. No taster seems to be able to put aside their preferences when their representations are described. Brochet adds that this result – the dependence of representations on preferences – is well known from the fragrance world.
5. Colour is a major factor in organising the classes of descriptive terms used by the tasters and has a major influence on the sort of descriptors used.
6. Cultural information is present in the sensorial descriptions. Interestingly, Brochet states that 'certain descriptive terms referring to cognitive representation probably come from memory or information heard or read by the subject, but neither the tongue nor the nose could be the object of the coding'.

Behavioural analysis: perceptive expectation

In the next set of experiments, Brochet invited 54 subjects to take part in a series of experiments in which they had to describe a real red wine and a real white wine. A few days later the same group had to describe the same white wine and this white wine again that had been coloured red with a neutral-tasting food colorant. Interestingly, in both experiments they described the 'red' wine using identical terms even though one of them was actually a white wine. Brochet's conclusion was that the perception of taste and smell conformed to colour: vision is having more of an input in the wine-tasting process than most people would think. Brochet points out a practical application of this observation, which has been known for a long time in the food and fragrance industries: no one sells colourless syrups or perfumes any more.

In a second, equally mischievous experiment, Brochet served the same average-quality wine to people at a week's interval. The twist was that on the first occasion it was packaged and served to people as a vin de table, and on the second as a grand cru wine. So the subjects thought they were tasting a simple wine and then a very special wine, even though it was the same both times. He analysed the terms used in the tasting notes, and it makes telling reading. For the 'grand cru' wine versus the vin de table, 'a lot' replaces 'a little', 'complex' replaces 'simple' and 'balanced' replaces 'unbalanced' – all because of the sight of the label.

Brochet explains the results through a phenomenon called perceptive expectation: a subject perceives what they have pre-perceived, and then they find it difficult to back away from that. For us humans, visual information is much more important than chemosensory information, so we tend to trust vision more. Brochet uses these results to explain Peynaud's observation that 'blind tasting of great wines is often disappointing'.

Variation in representations

A further study in this series examined how the qualitative ratings of a series of wines differed among a group of wine tasters. Eight tasters were asked to rank 18 wines, which they tasted blind, in order of preference. The results differed widely. With a similar methodology to that employed by Scanderberg's Italian researchers, Brochet then used MRI to assess the brain response of four subjects to a series of wines. One of the most interesting results obtained with this technique was that the same stimulus produced different brain responses in different people. In terms of brain area activated, one was more verbal, another more visual. Also, when a subject tastes the same wine several times, the images of each tasting are somewhat different. Brochet concludes that this demonstrates the 'expression of the variable character of the representation'. The representation is a 'global form, integrating, on equal terms, chemosensorial, visual, imaginary and verbal information'.

Dr Charles Spence from the Department of Experimental Psychology at Oxford University has also gathered relevant data on this sort of cross-modal sensory processing. I asked him about how his studies might apply to wine. 'Here in my lab we do a number of studies looking at how what people see influences their perception of the flavour identity and intensity,' says Spence. 'However, unfortunately, we can't give people alcohol, because of the danger of litigation, so we do most of our studies with coloured soft drinks, looking into which colours are particularly effective in modulating flavour perception. It turns out that one of the reasons why red colouring [is] such a powerful driver of what we experience (both in terms of smell and taste) is that redness typically equates with the ripening of fruits in nature.' Spence thinks that both semantics and experience are also important. 'Expectations or labels about what something might be can play a key role in how you interpret an ambiguous or bivalent odour,' he adds. 'Surprisingly, expertise doesn't seem to help with the red-wine colour effect. I have seen experts completely fooled, perhaps even more than novices. The thing is that many of these multisensory interactions occur pre-attentively. In other words, given the overload in the amount of sensory stimulation that is constantly bombarding each of our senses, our brains try to help out by binding what we see, hear, taste et cetera automatically and only giving us awareness of the result of this integration. Hence, attention also fails to impact on many of these cross-modal illusions.'

Spence also has something to say about the importance of learning, which he thinks plays a very important role. 'I have not seen this studied for the case of wine tasting, but for other combinations of taste and smell, your previous experience [for example, in terms of cultural differences in exposure to certain foods or to certain combinations of tastants and odorants] critically determines how your brain will bind the different sensory cues. The brains of Westerners, for example, are especially geared up to binding sweet tastes in the mouth with almond-like odours, but not salty tastes with almond odour. Go to Japan and the reverse is true, because Japanese people never experience the combination of sugar and almond but instead get a lot of exposure to almond and salt taste in pickled vegetables and condiments.'

Conclusions

While there is a lot still to discover about how the brain constructs our experience of wine, it is already clear that this is a complex area that we often try to simplify. It is our attempts to simplify the concepts underlying wine tasting and iron out the very real inter- and intra-individual variation that leads to problems in the interpretations of results from tastings. There is a lot more to the wine experience than just smell and taste: the basic information from these chemical senses is supplemented in a very real way by other input – for example, from vision, touch and memory. Added to this, the higher-order integration of all this input is a flexible and complicated processing stage that then forms our unified perception (or 'representation') of the tasting experience. The important results of Brochet and others show that factors such as whether or not we are tasting blind make a crucial difference to the nature of this representation, and that representations of the same wine differ quite markedly among tasters. Furthermore, the past experiences of tasting will change the nature of our current experiences. Information of this nature should help us in our understanding of the scientific underpinnings of the wine-tasting process and help in the design of tastings. For example, panel tastings where consensus is sought look doomed to failure. It is likely that further studies using similar techniques to those described here will give us a greater understanding of the rather complex business of tasting and describing wine.

In closing, I'll throw out some tentative ideas that I haven't been able to develop here because of space constraints. First, I think that we already have enough evidence here to warrant a paradigm shift with regard to rating wines. What critics are scoring is not some intrinsic property of the liquid in the bottle, but a perceptual representation that is to some degree specific to them. Does this mean that we can't have a shared experience when we taste the same wine? While it's helpful to acknowledge the individual nature of these representations, we also need to bear in mind that one of the remarkable properties of the human mind is its ability to exploit shared space, thanks to language and the development of writing and other recording technologies. The laptop on which I am writing this article is effectively acting as an extension of my brain. It gives me the ability to take my thoughts, in word form, and then develop them over an extended period of time. Most importantly, I can then share these thoughts with others and, in turn, access extensions of their mental landscape in a similar fashion. With wine tasting, our sharing of experience through a common culture of wine enables a degree of calibration of perceptual representations to occur. In particular, we develop a language for sensory terms – a way to encode and share our representations. The language we use for describing wine is intrinsic not only to sharing those ideas but also to forming them in the first place. By possessing an extended vocabulary for taste, smell and flavour sensations, we are able to approach wine tasting in a structured fashion and in a way that generates a detailed verbal description of the wine being analysed. It follows that the nature of this vocabulary will shape the description of the experience, and even the experience itself. ■

THE PEPSI CHALLENGE AND WHAT IT TELLS US ABOUT WINE TASTING

Read Montague, a neuroscientist at Baylor College of Medicine in Texas, devised a fascinating experiment that has implications for wine tasting. It stemmed from a series of TV commercials in the 1970s and '80s in which individuals were subjected to the 'Pepsi challenge'. In this test, Pepsi was pitted against Coke blind, with subjects not knowing which was which. They invariably preferred the taste of Pepsi, but this wasn't reflected in their buying decisions. Montague wanted to know why.

So he re-enacted the Pepsi challenge with volunteers. The difference was that this time their brain activity was being scanned by an MRI machine. On average, Pepsi produced a stronger response in the ventral putamen, a region thought to process reward. In people who preferred Pepsi, the ventral putamen was five times as active when they drank Pepsi as it was in Coke-preferring subjects drinking Coke.

In a clever twist, Montague repeated the experiments, this time telling subjects what they were drinking. Remarkably, most of them now preferred Coke. The brain activity also changed, with activity in the medial prefrontal cortex, a region that shapes high-level cognitive powers. The subjects were allowing what they knew about Coke – its brand image – to shape their preferences. Remarkable.

The implications for wine tasting are clear. When we don't taste blind, our preferences are liable to be shaped by pre-existing information we have about the wine. As hard as we try to be objective, this isn't possible. What we know about wine will mould how we perceive the wine, and it will even shape how much we enjoy a particular bottle. This brings another fascinating level of complexity to wine tasting.