Closing the label door

The US Senate has agreed a curious compromise on how to identify GM foods. Researchers and policymakers must now tackle more pressing issues with the technology.

Of all the debates over genetically modified (GM) crops, arguments on the need for labels to identify GM food might seem one of the more trivial. From a scientific point of view, by the time a product has reached the shelves, the various tests and standards have long assured its safety. Safety seems the only rational reason for shoppers to reject a food, and therefore the only need for a label.

The problem with that attitude is that it helps to explain why the lack of labelling of GM foods has created so much controversy. If consumers feel that they are being denied a choice, then they tend to object. Hiding information about ingredients has made consumers wonder why it was hidden. It has created an atmosphere that has fostered conspiracy theories, not a deeper understanding of the issues at hand.

Last week, the US Senate passed a bill that will finally create federal standards for GM labels. Widely expected to be passed by the House of Representatives, the bill is clearly a political compromise. Like many good solutions to complex problems, it leaves both sides in the debate feeling hard done by. The law gives federal regulators responsibility to develop mandatory labelling standards, but does not require labels to be printed directly on the products. Instead, consumers can be directed to a website, for example.

It is a solution that could create fairly obscure labels and fully satisfies neither of the two vigorous and vocal sides in the debate. Those are the activists, who argue that consumers should have ready access to information about their food, and the industry lobbyists, who argue that such labels would unfairly taint GM foods — products that a panel convened by the US National Academies of Sciences, Engineering, and Medicine reported, again, in May are safe to eat.

The curious decision reflects the pressure of the atmosphere in which it was forged. Members of the US Senate agricultural committee have been scrambling to find a palatable national standard for months, under intense pressure from industry. The clock was ticking: on 1 July, Vermont became the first US state to enact a law governing such labels, and food manufacturers faced an emerging and confusing regulatory patchwork as other states followed suit.

Now, at least, those who are motivated will be able to find the information they seek. And because federal law trumps state regulations, the new system seems more workable and sensible. The state initiatives seem unusually broad given that the country grows so many GM crops. Whereas some countries provide exemptions for ingredients that are present in trace amounts, or for foods in which the product of genetic engineering — for example, the protein responsible for tolerance to an herbicide — is no longer present, Vermont's law provided no such distinction.

The Senate compromise also promises to address the patchwork problem. The Vermont law, for example, could not supersede the US Department of Agriculture's authority over certain meat products. As a result, a frozen cheese pizza could require a label if it contains oil made from transgenic soya beans, whereas the same pizza with added pepperoni might not. Federal legislation would do away with such artificial and bewildering distinctions.

But perhaps more importantly, quenching the labelling debate could open the door to discussions about more pressing matters. Vast resources — both time and money — have been poured into the labelling debate. There is an opportunity now to redirect those resources.

> ***"Quenching the labelling debate could open the door to discussions about more pressing matters."***

In June, the US Environmental Protection Agency's inspector general determined that the agency was not doing enough to cope with the rise of insects resistant to the pesticide produced by some GM crops. Superweeds that are resistant to the herbicides used on certain GM crops are also plaguing farms. And sophisticated gene-editing technologies are helping to bring a new breed of engineered crops to market, yet regulators are still grappling with how to handle them.

Each of these issues is steeped in complex science, and researchers should seize every opportunity to inform — and encourage — discussions around them. The battle over labels has been bruising, and many researchers are hesitant to enter the fray surrounding GM crops. But without their input, the discussion is unlikely to progress. ■

Lend me your ears

A study of how people perceive music shows that jarring chords are a cultural contrivance.

Writing about music has been compared to dancing about architecture, but bear with us.

Santa Maria is a village in western Bolivia without running water or electricity, and so remote that it can be reached only by canoeing up a tributary of the Amazon. It is home to the Tsimane' people, who detect no difference between consonant and dissonant sounds — the relationships between notes that make, for example, 'Eleanor Rigby' by The Beatles sound so sad.

Dissonant chords are the unstable isotopes of Western music; they sound tense and want to revert to more stable forms. The way that composers create and resolve this tension usually invokes different moods in the listener. But not in the Tsimane'.

As researchers describe in a paper this week, when they tested the musical discrimination of the Tsimane' villagers, the listeners experienced consonant and dissonant intervals as equally pleasant (J. H. McDermott *et al. Nature* http://dx.doi.org/10.1038/nature18635; 2016). This is not a deficiency of affect, because the villagers can distinguish cheerful sounds (laughter) from less cheerful ones (gasps). They also recognize physically unpleasant sonic 'roughness' — the beating sensation when two tones close in frequency are played at once.

The reason for the villagers' inability to distinguish what others would call pleasant sounds from unpleasant ones might be, in large measure, one of culture. The Tsimane' do have music, but it is purely one of melody rather than harmony. They play or sing in single lines, and do not adhere to Western scales. This seems odd to those immersed in the European musical tradition, with its clear differences between pleasant and disagreeable harmonies.

The differences are so clear, in fact, that we are inclined to think of them as innate. The mathematics behind the music seems to back this up. Consonant intervals, such as an octave, perfect fourth or perfect fifth, are integral ratios of harmonics — 2:1, 4:3 and 3:2, respectively. A reliably dissonant interval such as the augmented fourth, or tritone, has an irrational ratio of $\sqrt{2}$:1. Consonance and dissonance seem to be written into the fabric of the Universe. But the Tsimane' results show that these structures are a human interpretation, and one that seems to be learned by experience.

The tale of the Tsimane' should remind us that Western music was not always as richly polyphonic as it is now. In medieval times, music was as melodic as that of the Tsimane'. Chords were unknown, and so were modern musical scales. There were just eight notes, corresponding to the white notes on a keyboard. The earliest keyboard instruments had no black keys, and indeed no such thing as a musical key. Instead, there were 'modes', each determined by the unequal spacing of intervals, depending on which note you started from.

But then the Devil arrived, in jumps of three whole tones, in particular between F and B. This was the tritone, so obnoxious that ecclesiastical authorities described it as *diabolus in musica* ('the Devil in music') and banned it. Choristers presented with singing a tritone preferred to flatten the B, making a much more agreeable perfect fourth. Keyboard technology caught up by inserting the first black key, a B flat. The other black keys followed in time, and modal music evolved into the system of keys that we have today, followed rapidly by that most daring of innovations — polyphony.

"The Tsimane' of Bolivia know nothing of Bernstein, let alone Birtwistle."

It is fair to say that the entire edifice of Western music has been built on the tension between consonance and dissonance. The music of Beethoven and Queen's 'Bohemian Rhapsody' take the listener on journeys that make sense only within that framework. Composers Harrison Birtwistle and Pierre Boulez travel routes that redefine the meaning of dissonance and (it must be acknowledged) thrill smaller audiences. Most readers of *Nature*, we hope, can resonate with the heartache and absolution in the song 'Maria' from Leonard Bernstein's *West Side Story*, in which Tony sings the name of his inamorata — using a tritone that immediately resolves into a perfect fifth.

The Tsimane' of Bolivia know nothing of Bernstein, let alone Birtwistle. Even when their traditional tunes were recorded, shifted in pitch and harmonized to make polyphonic arrangements and create consonance and dissonance, the listeners could not tell the difference between the two. One hopes that their patience wasn't tried too sorely by outsiders playing fast and loose with their heritage (there are those of us who still bear the scars of hearing Bach murdered by The Beach Boys).

But the key finding, the resolution, the crescendo, the cadenza, the Tierce de Picardie — one is tempted to say — is that the Tsimane' do not find the tritone any more or less pleasant than any other interval. The Devil has not reached that part of Bolivia, it seems, and the tunes of the Tsimane' might be such as those played in Eden. ■

Fifty shades of pain

The push to find reliable ways to measure pain is proving harder than generating it.

Science has produced such a bewildering array of tools and techniques to cause gentle pain that to list them all can seem like describing a torture chamber in Toytown. To study the body's responses, people are prodded with fingers, pricked with needles and pressed with ice. Toes are squeezed and ear lobes pinched. Muscles can be poked with sticks and zapped with electricity. Mustard oil is spread on the skin and capsaicin injected beneath it. Laser pulses offer a double hit: an initial prick followed by a burning sensation.

When properly performed, these human experimental pain models help researchers to understand both the mechanisms of pain and the effectiveness of new compounds that could help to relieve it. The translational bridge from animal experiments to human trials is built on the backs of countless volunteers who sign up for a little lab-based agony. (Special thanks indeed must go to the anonymous 18 brave souls who had "two series of rectal balloon distensions performed on two separate days" to help to study "cortical processing of visceral sensations and pain" (D. Lelic *et al. Neurogastroenterol. Motil.* **27,** 832–840; 2015).)

Similar studies check on the pain caused by fully inflating a balloon inside other internal organs. Although, as a review of these pain models noted in 2012, it is (perhaps counter-intuitively) more difficult to find people who are willing to take such balloons through the mouth to stretch the oesophagus: "Difficulties in tolerating balloon distension commonly results in poor recruitment rates as well as the potential for esophageal perforation" (K. S. Reddy *et al. J. Res. Med. Sci.* **17,** 587–595; 2012).

When it comes to assessing, measuring and reducing pain, the science toolbox is less well stocked. We have thankfully moved on from the earnest 1950s debates about how the pain tolerance of patients was linked to eye colour — discussions that were themselves coloured by racism. But there is much about pain that we still do not realize, and important knowledge remains beyond the reach of even the best-placed balloon.

Some of what we do know is presented this week in an Outlook supplement (www.nature.com/pain). A series of articles describes the physical, neurological and psychological factors that seem to contribute, and offers a snapshot of current thinking on the best forms of relief.

Science and medicine no longer use a person's ethnicity and religion to mark how well they will tolerate the pain of a procedure, but equally, researchers have not yet found a reliable way to measure pain tolerance. The search for quantifiable ways to compare painful sensations, and to diagnose pain in those who are unable to communicate it, mirrors the effort in psychiatric research to find useful biomarkers for mental-health disorders.

For pain, expression of inflammatory mediators in the blood and the presence of metabolites in saliva could be biological guides to a person's distress. So, too, could brain scans that reveal the neural signature of chronic pain. However, as *Nature* pointed out last year (*Nature* **518,** 456; 2015), such techniques must be introduced with care, not least because they could be used by insurance companies and others to demand 'proof' of pain as a way to overrule reported personal experience.

Science has already developed some weird and wonderful ways to deliberately cause pain. It should be wary that it does not inadvertently create some more. ■