Synaesthesia

Is a common and harmless perceptual condition

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"One of the synaesthetes describes her world as a 'weaved cheesecloth of sound.' Another says that she became more aware of her condition when she heard an orchestra playing, saying, 'I didn't realise it was individual instruments. I thought there was some sort of coloured quilt.'"
BMJ technical editor Sally Carter in a blog about a film on synaesthesia. http://blogs.bmj.com/bmj/

For more blog extracts, see OBSERVATIONS, p 244

Imagine a world of magenta Tuesdays, tastes that have shapes, and wavy green symphonies. At least 1% of otherwise normal people experience the world this way—in a harmless neurological condition called synaesthesia. In synaesthesia, stimulation of one sense triggers anomalous perceptual experiences.[1 2] For example, a voice or music may be not only heard but also seen, tasted, or felt as a touch. Synaesthesia is a fusion of different sensory perceptions: the feel of sandpaper might evoke an F sharp, a symphony might be experienced in blues and golds, or the concept of February might be experienced above the right shoulder. Synaesthetes are typically unaware that their experiences are unusual. In the linked article, a patient describes her journey with synaesthesia.[3]

Synaesthesia comes in many varieties, and a person can have several different types. Experiencing letters and numbers with colours or textures is an especially prevalent form (fig a)[4] that affects at least 1% of the population.[5] The woman in the patient's journey reports her first hand experience with this form of the condition,[3] known as "grapheme-colour" synaesthesia. Other common varieties include experiencing colours in response to sounds, or tastes in+ response to words.[1] Another very common form is spatial-sequence synaesthesia, in which a person perceives sequences (such as numberlines, years, or weekdays) as having a spatial three dimensional form.[6] For example, someone with this form of the condition may say that Monday is in front of them to the right, next to that is Tuesday, and so on, with specific locations to which they can point.

Synaesthetic perceptions are typically basic: people sense things like simple colours, shapes, or textures, rather than something pictorial or specific (for example, synaesthetes do not say, "This music evokes a vase of flowers on a restaurant table"). Moreover, the particular synaesthetic pairings (for example, number 3 is purple) are unique to each person. Synaesthetic perceptions are involuntary, automatic, and consistent over time.

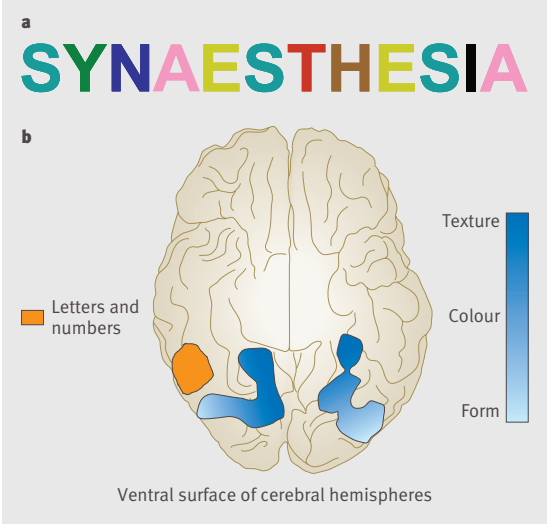
Synaesthetic experiences are not hallucinations. Synaesthetes do not think that their synaesthetic perceptions exist in the outside world—instead they are internal experiences (in "the mind's eye") and recognised as such.

Although synaesthesia was first described in *Nature* 126 years ago,[7] its study was hindered for almost a century from a lack of tests to verify the phenomenon. Synaesthesia can now be rigorously phenotyped thanks to simple diagnostic tests (www.synesthete.org).[8] Such tests use the fact that synaesthetes are consistent in their letter-colour matches over years, a feat that cannot be imitated by controls. In recent years, the authenticity and automaticity of synaesthesia have been confirmed by functional magnetic resonance imaging.[9]

Synaesthetic brains reflect crosstalk between normally separated brain areas, such that activity in one area kindles activity in another (fig b). Whether this crosstalk results from increased physical connectivity between areas or a slight imbalance of inhibition and excitation is unknown. Interestingly, synaesthesia clusters in families, and the patterns of inheritance suggest the possibility of a single dominant gene.[10 11] A large scale genetic study (a family linkage analysis) is currently mapping the gene(s) that correlate with coloured sequences (such as letters and numbers).[12] Understanding the genetic basis of synaesthesia should clarify the different neural hypotheses.

Synaesthetes do not seek medical help—nor should they—and they do not need support groups. They accept the reality presented to them, as we all do. (Analogously, we would not expect a colour blind person to suggest a support group for those with normal vision under the assumption that "seeing all those colours" must be troubling.)

Doctors, parents, and educators should all be aware of this condition to avoid showing misplaced concern when hearing a synaesthete's unusual description of the world. It is far too common for synaesthetes to be stigmatised as saying something "crazy" when they describe



(a) Representation of the colours evoked by individual letters in a word for a grapheme-colour synaesthete. (b) Synaesthesia seems to result from higher than normal crosstalk between neighbouring areas in the brain—in this case the nearby brain areas involved in graphemes (orange) and those involved in colour, texture, or form (shades of blue). Adapted from Eagleman and Goodale[4]

their perceptual experience—a point germane to why the patient described by Logsdail stopped talking about her synaesthesia for 25 years.

Given the high prevalence of synesthesia, doctors need to know about this phenomenon in case they mistake it for a peculiar type of cognitive fragmentation.

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Home based cardiac rehabilitation

An effective way of widening access to preventative services

HOMER SYKES/ALAMY

RESEARCH, p 249

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In the linked systematic review, Dalal and colleagues assess the effect of home based cardiac rehabilitation on mortality and morbidity, health related quality of life, and modifiable cardiac risk factors in patients with coronary heart disease.[1] They found that home based cardiac rehabilitation was as effective and efficient as centre based rehabilitation at reducing mortality and cardiac events; improving risk factors such as exercise capacity, systolic blood pressure, and total cholesterol; and increasing health related quality of life. This finding is consistent with another recent meta-analysis,[2] which found that home based programmes provided by "telehealth" show promise in reducing mortality and can lead to clinically significant benefits in cholesterol, blood pressure, and prevalence of smoking.[2] As with centre based programmes,[3 4] a variety of home based programmes can improve health and quality of life outcomes in suitable patients.

Providing programmes in the patient's home makes sense because of what is needed for risk factor reduction. To improve morbidity and mortality, health behaviours must be sustained for at least two years.[4] Home based programmes can provide support for these behaviours longer than the usual two to three months offered by hospital based cardiac rehabilitation, the most common type of centre based rehabilitation.

However, centre based programmes have several potential advantages. Some patients prefer the reassurance and perceived safety offered by a clinical setting. They also provide more face to face access to health professionals from different disciplines, opportunities to do supervised group-based exercise, and contact with other patients. For patients with more complicated or chronic health needs, specialists from centres can design tailored programmes. Yet, the greater centralisation needed to provide these types of programmes is often accompanied by lower access, relatively weak links to general practice and the local areas in which patients try to sustain healthier lifestyles over the long term.[5]

The home is the most natural place to situate long term support for secondary prevention because it provides constancy, familiarity, and family support. Home based programmes are important because the large population with established coronary heart disease has high levels of modifiable risk factors but is difficult to reach with centralised programmes.[6 7] Uptake of hospital based programmes is consistently lower in groups most in need of support for risk factor reduction, including women, elderly people, people in different ethnic groups, and people of low socioeconomic status.[6] Ensuring access to centre based services is more challenging in large countries. Even in high income countries with universal and free access to cardiac rehabilitation, such as Australia and Canada, rural populations have limited access to centre based programmes. Home based programmes overcome many of the most common barriers to participation in these populations and settings.

Despite the potential of home based programmes, they do have important differences that may influence their effectiveness. Some home based interventions, notably those based on the *Heart Manual*,[8] have a more substantial theoretical basis and require clinical providers to be trained to a more advanced level. Language, health literacy, ethnicity, and cultural appropriateness are further local considerations that must be tackled when developing a home based programme. Where possible, new home based programmes should draw on established models but adapt them to local populations and needs.

Dalal and colleagues' analysis is not without weaknesses.[1] Patients in the trials were younger, healthier, and likely to be wealthier than patients in clinical practice. However, this is the case with most trials of secondary prevention programmes,[3 4] and the overall quality of the analysis is strengthened because the trials included were of moderate quality. Just under half of the home based programmes included were "exercise only" interventions, but for more than a decade it has been recommended that secondary prevention services be multifactorial—most now include physical activity, smoking cessation, diet and weight, and psychosocial health elements. The authors do not adequately explore how the characteristics of the home

based programmes influenced outcomes, despite considerable heterogeneity in trial samples, trial settings, and programme characteristics. To tackle this problem and explain variations in trial results in future meta-analyses, published trials should contain more comprehensive descriptions of programmes and the care given to intervention and comparison groups.[9]

The findings emphasise the importance of patient choice in determining the services offered. Giving patients choice about the type of programme they will receive increases access to services and leads to health benefits even in patients who have previously decided not to use centre based programmes.[10] This choice is not only between home based and hospital based services but should extend to a range of settings and delivery mechanisms. Taking account of all existing evidence, home based multifactorial cardiac rehabilitation is one of several effective models of providing secondary prevention services, including face to face risk factor counselling clinics and programmes provided by specialists and trained generalists in community settings and general practice.[3 4] Because programmes have additional benefits to those arising from medicines and foster greater responsibility for self care and health behaviours, the case for increasing investment in programmes is persuasive.[11] Each model has strengths and weaknesses, but home based programmes can help fulfill an over-riding priority that—irrespective of sex, age, race, location, or social status—all eligible patients can use secondary prevention services.

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Smoking cessation

It is never too late for people to stop, even when they have lung cancer

RESEARCH, p 251

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Do we need more evidence on the harm done by smoking? Smoking is a major contributor to common diseases such as heart attack, stroke, peripheral vascular disease, and chronic obstructive pulmonary disease. In addition, most lung cancers are caused by smoking and it is also a risk factor for cancers of the breast and bowel. The blogger who wrote last year that smoking bans were illiberal and "justified by bullshit science"[1] will have gained little informed support. Smoking costs life and limb; smokers are even prematurely wrinkly.[2]

The linked study by Parsons and colleagues adds more to the evidence. The meta-analysis of the effect of continued smoking after a diagnosis of mostly early stage lung cancer shows that continued smoking substantially increases the risk of death, and that a large proportion of the increased risk is the result of cancer progression rather than cardiorespiratory disease. The estimated effects are large, with five year survival in "quitters" in the order of 60-70% compared with about 30% in those who continue to smoke.[3] Patients and those caring for them should be given this information because the potential benefit is great. The problem is, however, that fewer than one in three patients with lung cancer survive even one year, so the patients likely to benefit are probably healthier to begin with. So, although the information is valuable its application may be limited.

Perspectives differ among healthcare professionals who have to advise patients with lung cancer. Some discuss smoking habits with all patients and caution against smoking. Others think it is inhuman to dwell on the matter—that it adds to feelings of guilt and takes away a life long comfort from the dying patient. At the extremes this results in stereotyping the opposing factions as zealots and nihilists. In support of those who would tone down antismoking harangues (most patients diagnosed with lung cancer are in the last months of their lives) are recent reports from the National Confidential Enquiry into Patient Outcome and Death (NCEPOD). They found that aggressive but unavailing cancer treatment was still being given to some patients too near to the end of their life,[4] and that hospital care did not always switch in a sensitive and timely fashion from sustaining life to allowing natural death.[5]

Smokers themselves are well informed of the harm. It is written in big black letters on every cigarette packet: smoking kills. So why don't they stop? Smoking is comforting and pleasurable. The traditional image is that the first thing a comrade would do for a wounded soldier was to light a cigarette and place it tenderly between his lips, and in the mud and blood of the first world war they sang, "While you've a Lucifer to light your fag, smile, boys, that's the style."

Smoking is the most efficient way to deliver nicotine. It reaches the left side of the heart via the lung capillaries

and in seconds it is on its way to the brain, much faster than an intravenous injection. The experienced smoker titrates the rate of rise and the desired plateau of the drug according to the required effect, varying from deep stress relieving gasps to languid dose maintaining puffs. And it doesn't seem to have the negative effects of other drug habits; it enhances rather than impairs concentration and mental performance, at least for the addict. This is not to laud smoking—there are very few patients for whom continued smoking does not do further harm—but in a battle you must know your enemy, and the power of smoking addiction is formidable.

Knowing that you shouldn't smoke isn't enough. If we want to help people to stop smoking we need to do more than just tell them that it is bad for them. As for all treatments, expertise, a knowledge base, skills, and strategies are important.[6 7] For example, if patients aren't good at attending for help, reach them on their mobile phones.[8]

Even better than getting smokers to stop would be to stop them starting. Large numbers of young people smoke. It used to be said that after 10 years of abstinence the risk of lung cancer falls to background values. This created the illusion (for those who could do simple arithmetic and had a smattering of epidemiology) that someone could smoke with impunity in their teens and twenties and stop at about 30, and because almost nobody gets lung cancer before 40, the 10 years would have elapsed and they would be in the clear. This is not true though—even if people do manage to stop smoking as planned, the legacy of the cigarettes smoked does not go away. So the sooner people stop the better, but the real gain would be in stopping young people from starting altogether.[9]

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Preoperative non-invasive stress testing

Should be reserved for patients at high risk of perioperative cardiac complications

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Stress testing is commonly used for diagnosis and risk stratification of patients with coronary artery disease. The aim of preoperative stress testing is to reduce morbidity and mortality after major non-cardiac surgery, but a positive test often results in delay of surgery and subsequent coronary or pharmacological interventions.

In the linked retrospective cohort study, Wijeysundera and colleagues assess the effect of non-invasive cardiac stress testing before elective intermediate to high risk non-cardiac surgery on survival and hospital stay. They found that preoperative non-invasive stress testing was associated with higher rate of preoperative cardiac procedures, improved survival at one year, and reduced length of stay in hospital. This survival benefit mainly applied to patients at high risk of perioperative cardiac complications (revised cardiac risk index (RCRI) 3-6: hazard ratio 0.80, 95% confidence interval 0.67 to 0.97, number needed to treat 38). In contrast, stress testing was of only minor benefit in patients at intermediate risk (RCRI 1-2: 0.92, 0.85 to 0.99) and was associated with harm in those at low risk (RCRI 0: 1.35, 1.05 to 1.74).[1]

Clinical registries have been useful for creating evidence based healthcare policy in Canada. The strength of Wijeysundera and colleagues' study is that the population is large, unselected, and came from a well established government administrative database. Cases and controls were also comprehensively matched for preoperative clinical covariates and intraoperative care using propensity score methods (n=23 060 who had preoperative stress testing and n=23 060 who did not).

The results reaffirm the American College of Cardiology/American Heart Association (ACC/AHA) guidelines that recommend preoperative non-invasive stress testing in patients at high risk of cardiac complications (RCRI 3-6).[2] Importantly, the study confirms the recommendation that preoperative stress testing should not be performed in low risk (RCRI 0) patients because of the associated risk of postoperative harm. Wijeysundera and colleagues report that preoperative stress testing increased the use of preoperative invasive coronary angiography, percutaneous coronary intervention, and coronary artery bypass grafting, as well as planned postoperative care in a monitored bed.[1]

This study also agrees with the recommendation that preoperative non-invasive testing should not be used routinely in patients having major non-cardiac surgery who are at intermediate risk (RCRI 1-2).[1-3] One randomised study found that 30 day and long term rates of cardiac death and myocardial infarction in patients at intermediate risk undergoing abdominal aortic or infrainguinal arterial reconstruction surgery was sufficiently low to preclude preoperative stress testing, as long as the heart rate is tightly controlled with β blockers.[3] However, it is uncertain whether selected patients with intermediate risk and poor functional status may benefit from stress testing. This should become clearer as the prognostic value of stress testing improves.[4 5]

Wijeysundera and colleagues did not examine the effects of preoperative coronary or pharmacological interventions or perioperative monitoring on postoperative survival.[1] The CARP and DECREASE trials suggested that prophylactic coronary artery revascularisation did not reduce long term all


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cause mortality or improve outcomes in patients with stable coronary artery disease or in high risk patients undergoing major non-cardiac surgery.[6 7] In fact, preoperative coronary revascularisation increased the odds of death before non-cardiac surgery compared with medical management (odds ratio 8.86, 1.55 to 40.5).[8]

Patients with a coronary stent who are undergoing non-cardiac surgery present an additional challenge (myocardial infarction, thrombosis, and bleeding). Elective non-cardiac surgery should be delayed for at least six weeks after implantation of a bare metal stent and one year after implantation of a drug eluting stent.[9 10] The SYNTAX trial showed that when compared with percutaneous coronary intervention, coronary artery bypass grafting was associated with a lower rate of major adverse cardiac or cerebrovascular events at one year in patients with three vessel or left main coronary artery disease.[11] However, the study did not assess the effect of preoperative coronary intervention for non-cardiac surgery.

So what should clinicians do in the light of current evidence? At present, pharmacological intervention and perioperative monitoring are key to improving postoperative outcomes in intermediate-high risk patients undergoing major non-cardiac surgery. In general, antianginal drugs should be continued, but prophylactic calcium channel blockers or nitrates should not be added. Low dose aspirin may be safely continued in some cases, but it is difficult to make evidence based recommendations about the perioperative use of antiplatelet agents. The latest 2009 ACC/AHA focused update on perioperative β blockade recommends that β blockers should be titrated to heart rate and blood pressure in patients undergoing vascular surgery who have high cardiac risk because of coronary artery disease (or who have cardiac ischaemia on preoperative testing). It also states that routine administration of high dose β blockers in the absence of dose titration is not useful and may be harmful in patients having non-cardiac surgery who are not currently taking β blockers.[12]

Overall, the evidence suggests that preoperative non-invasive stress testing should be reserved for high risk patients, and that the survival benefits probably result from pharmacological intervention and monitoring rather than coronary intervention before non-cardiac surgery. Whether preoperative stress testing provides prognostic benefits in specific groups of patients at intermediate risk is unclear, but it should not be ordered in low risk patients.

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High reliability in health care

Examples from other industries should be informative, not prescriptive

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High reliability organisations achieve high levels of safety and performance in the face of considerable hazards and operational complexity.[1] The original studies by the Berkeley Group, which looked at nuclear power, naval aviation, and air traffic control, have been influential and inspired much comment and interpretation. High reliability organisations are frequently referenced as models to which health care should aspire, particularly because the environments and challenges are similar.[1-3]

Meeting the challenges of high reliability operations requires accountability, strong basic procedures, multiple procedural checks, and continual communication between operators.[2 3] For example, during critical operations on naval carriers, multiple checks and observations by different people ensure that dangerous conditions are detected rapidly. "Buddy" systems, in which individuals monitor each other's performance, are used to guard against unsafe actions. High reliability organisations also engage in varied training and simulation activities for a broad range of operational scenarios (such as deck fires on aircraft carriers) to prepare for crises and foster a flexible problem solving approach. Although there is a strong emphasis on protocol and procedure, staff of all levels of seniority have the authority to interrupt operations. For example, the landing signal officer on a carrier, who has a relatively junior role, has the authority to abort a landing attempt if safety is compromised.[3]

The original descriptive studies of these organisations are inspiring, but we need to be cautious about extrapolating their conclusions to health care. Firstly, while studies highlight a wide range of characteristics

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said to be important to reliable performance, it is not clear which are the most important. Secondly, however insightful subsequent authors have been, they have compounded these problems by selectively looking at the aspects they considered most important and have also offered new interpretations and terminology.[4-7] The range of alleged high reliability concepts is now enormous. Thirdly, theoretical abstractions abound, but few empirical studies have been done since those of the original Berkeley Group. Fourthly, the field has remained resolutely descriptive with few attempts to measure the characteristics of high reliability organisations or relate them to substantive safety outcomes.

A particular worry is that health care has been selective about the lessons of high reliability organisations and has neglected the role of basic procedures. Many of the organisations studied are solely military or include military personnel, which brings an acceptance and adherence to routines and procedures. In contrast, much of the literature in health care has focused almost exclusively on the response to the hazardous and unexpected, and it has neglected the solid foundations of training, procedure and standardisation, shared discipline, and commitment to working as a team.[8]

Health care is sometimes contrasted unfavourably with high reliability organisations, although it is just as demanding and complex an environment.[9] The problem is not that health care is not reliable or resilient at all, but that huge variability exists within teams, within organisations, and across the system. The hospital that contains centres of excellence may have other units in which outcomes are poor or even dangerous. Many instances of high reliability exist in health care, in the everyday behaviour of clinical staff and at a unit and hospital level. In surgery, for example, a small number of units around the world have achieved almost zero mortality during operations for gastric cancer and other conditions that are difficult to treat.[10]

The study of high reliability organisations has encouraged optimism about what can be achieved in health care and pointed to a much more proactive approach to safety than the more familiar reactive learning from incidents and adverse events.[11] The challenge now is to take this diffuse set of ideas, refine them, consider their implications, and test them in a healthcare context. Rather than health care being treated as the poor relation in high reliability terms, it should be seen as an ideal environment for testing and implementing some of these concepts.[12] Importing systems from high reliability organisations into clinical practice without considering how the task fits into the unique characteristics of the healthcare system is likely to be unproductive and potentially destabilising.

One solution is to look more carefully and systematically at high performance within health care, drawing on other industries for ideas and inspiration, but not as beacons of reliability that we should simply emulate. Individuals, teams, and organisations in health care that already embrace this perspective provide a means of understanding the nature of reliability and resilience, and they can be an inspiration to others.

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