NEUROSCIENCE

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The seductive allure of neuroscience

When we go to grab a burger we are allured by luscious pictures of succulent sandwiches, filled with tender beef, and moist with the most delicious sauces. Should we compare what we really get with the feigned advertisement, we would run a rudimentary scientific experiment. Which is the evidence that if I cross my palm with silver I will get exactly what it says on the tin? A claim should be supported by evidence. The same applies to most realms of science.

This is why randomised controlled trials are carried out and constitute the basis of treatment in medicine: to know whether or not a drug works, doctors give this drug to a group of patients affected by a particular disease, at the same time they give a "placebo", typically sugar pills, to another group of patients with the same disease. In so doing they are able to find out whether or not the drug has any beneficial effect over and above the placebo effect.

However, when it comes to brain related stuff, we abort our critical thinking and blindly accept unproven techniques.

The media, on the whole, like discussing matter of the brain. They like the colourful blobs showing which bits of the brain do what. We all do! Two recent published papers make this point very clearly. Weisberg et al. (2008, The seductive allure of neuroscience as an explanation, Journal of Cognitive Neuroscience, pp. 470-477) presented to lay people brief descriptions of psychological phenomena followed by right or wrong accounts of these phenomena. They found that when the wrong accounts contained some irrelevant reference to the brain, lay people were much more inclined to rate the explanation as satisfactory. The pervasive influence of brain images was further reiterated by McCabe and Castel (2008, Seeing is believing, Cognition, pp. 343-352). They demonstrated that a brain picture added to an argument made the argument much more acceptable and people rated it higher than the same argument without the picture of the brain.

Perhaps for this reason, most training programmes proposed as remedy for ailments and impairments make loose and implausible association to brain theories, to appear more convincing. For example, the simplistic dichotomy between the two brain hemispheres ill-inform a series of training programmes. Such programmes, the best known of which is the notorious Brain Gym, are based on the popular assumption that we have a creative half hidden in our right hemisphere, which needs to be awakened. How do we stimulate our dormant right hemisphere? By practicing movements based on fanciful concepts of brain anatomy and preposterous logic based on loose concepts like energy activation. The reasoning is doubly flawed: first it is not true that the left hemisphere epitomises the military-industrial establishment of the West, while the right brain has the glamour and mystery of the East; second even if this were true, we could not stimulate the right hemisphere by means of these asinine exercises.

We all wish to be more intelligent and show off to our friends and family our skills in solving puzzles, we would wish to have better memory and absorb volumes of material effortlessly, or to flaunt our astuteness and acumen at parties. However, to reach these goals by long hours of swotting seems a daunting enterprise, hence many jump at the idea of shortcuts and are prepared to cross palm with silver for a quick fix. People believe that their children could improve their scholastic performances by gulping up fishy pills or other improbable supplements. Newsmakers too often than it would be advisable fuel these beliefs in tall tales by running uncritical stories advertising preposterous methods and ignoring their obvious flaws. The only question that matters should be "Where is the evidence? And which is its source?".

Is there any evidence supporting the claim that by playing the Nintendo game one can actually improve their brainpower, or even counteract the ageing of the brain? So far we have little more than anecdotal reports, and several debunking studies. The original Dr. Kawashima's study included two groups of people suffering from Alzheimer's Disease, which is a severe degenerative condition progressively damaging the brain. Each group was followed up for six months in a nursing home in Japan. The difference between the two groups was that one group continued with the usual activities, while the other group engaged in a "learning therapy" method consisting in reading fairy tales and doing some simple mental calculations. The results indicated that the "learning therapy" group deteriorated slightly less than the non-treated group. However from this study it is impossible to disentangle whether this advantage was due to the extra mental stimulation or to the extra attention and social interaction that the treated group received. Moreover, speculating that some mental stimulation which allegedly slows the havoc caused by dementia should also long-lastingly improve the performance of healthy elderly requires a long leap.

We live in a very credulous world, several people are prepared to pay good money in the hope to achieve goals that would require more effort. As a rule of thumb, if something looks too good to be true, it usually is.

Embarrassing a neuroscientist

Cocktail party conversations can be strenuous for a brain scientist. Questions like "is it true that we only use ten percent of our brain?" leave the poor fellow nonplussed. The stoneless olive spiralling in his stirred dry Martini, the academic, struggling to retain his (it's a he) natural pomposity, puts on a stereotyped smile and utters that in fact this is not the case, that there is no evidence for such a claim, that all we know about the brain indicates that this assertion is sheer nonsense. But, given the weakness of the null-hypothesis argument, how can we convince somebody that something simply is not as they think?

Cognitive flaws

It seems safe to say that most people are of two minds about the mind. On the one hand, they dutifully don their helmets before hopping on their motorbikes and change their diets to avoid clogging their cerebral arteries—because they know that damage to the brain from accident or disease will wreak havoc on their ability to think, perceive, and respond. At some level, they are acknowledging that the brain is the organ of consciousness and that having an intact one is necessary for any semblance of normal mental activity. In this way, they are further conceding, whether they realize it or not, that if the brain is a physical organ, whose operations are bound by well-established physical, physiological and psychological principles, then certain cherished beliefs about the mind and its alleged powers are on rather shaky ground. On the other hand, many of these same people shove this inconvenient implication—which is as well-supported as any in science—aside and line up to buy any doctrine, course, exercise, or gadget that offers to mitigate this unpalatable corollary of the proposition that mind equals brain function. Consequently, entrepreneurs rarely go broke selling books or documentaries that assert that minds can leave bodies and still see, hear and remember, or that powerful spiritual entities can play us like unseen puppeteers. Poll after poll attests that a substantial majority believes that people can bend spoons with their bare minds and "see" through walls and the barrier of time. Hucksters successfully peddle power drinks, mental exercises and devices that purportedly create super brains, even though such claims fly in the face of most up-to-date evidence in modern neuroscience. Note the inconsistency here: dualists who fundamentally believe that the mind is a spiritual rather than a physical, brain-produced phenomenon, trying to enhance their immaterial minds by refurbishing their material brains. Claims of this sort seldom disappear, of course, because they offer substantial comfort to the believer. Thus, profitable but ridiculously tall tales of the mind and brain recycle endlessly despite the best efforts of the scientific community to debunk them. Hope really does spring eternal it seems. Newsmakers too often than it would be advisable fuel these beliefs in tall tales by running uncritical

stories advertising preposterous methods and ignoring their obvious flaws. The only question that matters should be “Where is the evidence? And which is its source?”. Is there any evidence supporting the claim that by playing a Nintendo game one can actually counteract the ageing of the brain? Is there any evidence that forcing primary school children to make unsubstantiated daft exercises, as those proposed by Brain Gym, will improve their brainpower? So far we have little more than anecdotal reports, and several debunking studies. Show me the evidence!

Mind Myths

Myths are beautiful fables devised to account for all the mysteries of life and death. Few people now would maintain a supernatural cause of infections, though only little more than a century ago, before the discovery that bacteria caused diseases, this was the common view. In the dearth of understanding of the mechanisms of the mind and the brain, and the effects of their diseases, we still tackle their mysteries by aping early man: invoking divine intervention or taking shelter in simplistic dogmas.

Popular books sustaining such myths overflow from the shelves of the science section of several bookshops. We live in a very credulous world: in the country where I live, the heir to the throne supports unproven treatments whereas the wife of the ex-PM praises the virtues of crystal healing. In the country where I come from people believe in miraculous events, which are unfortunately never spectacular (grow a new leg in an amputee) but rather petty (healing from a disease which has limited but quantifiable chances of healing with time). Any right-minded alien visiting us would wonder whether there is intelligent life on earth. As with most domains of human knowledge, the various disciplines loosely lumped together as neurosciences are not exempt from personal beliefs, prejudices, faith, hopes, hunches, and ultimately, myths. The neuroscience and psychology literature is the principal myth-maker. Nevertheless, the scientific tradition has embedded rules which decrease the chance of blunders existing for very long. The acceptance of these rules in accruing knowledge marks the difference between science and beliefs, between what we do know about the mind and the brain and what we think we know about them. Perhaps more important, accepting these rules allows us to admit what we do not yet know, and avoids the pompousness too often linked to science and scientists.

A number of misconceptions about brain mechanisms are taken for granted even by well-read, educated people. These include the belief that people can be resuscitated from a coma by listening to their favourite songs; that magic pills preventing ageing do exist; that we can be trained to capitalise on non-physical energies of the brain; or that one can retrieve pre-adolescent sexual abuse by means of hypnosis, that we have a creative, hippie half in our brain, the right hemisphere, opposed to a nerdy left hemisphere which acts as a rigorous accountant, from which believe it derives the false postulate that it would be desirable to stimulate the right side to enhance our hidden creativity. Not to mention the far-fetched idea that we only use 10% of our brain. Indeed, if this were true nine out of ten patients with a stroke would show no symptoms. Unfortunately this is not the case.

We will look in some more details at two such neuromyths: The ideas that listening to Mozart music makes one more intelligent and that memory works as a video-camera allowing one to learn a language by listening to tapes while sleeping.

The Mozart effect

In the film Phenomenon, George Malley (played by a grievously miscast John Travolta), having been struck by a beam of light from outer space, finds himself with an intellect of galactic proportions. We all wish we were more intelligent. In recent years the ‘Mozart effect’ promised to deliver just that, and rather effortlessly.

The story began in 1993 when Gordon Shaw and his colleagues (REF) of the University of California, reported that 36 college students, after listening to Mozart’s Sonata for Two Pianos in D Major (K488) for only ten minutes, achieved scores on standard spatial tasks from the Stanford-Binet intelligence test which were fully 8-9 IQ points above the levels they achieved either after listening to a relaxation tape or experiencing complete silence for the same length of time.

Don Campbell, an entrepreneur, was the quickest in capitalising on these findings, he termed them “the Mozart effect”, and became rich by selling the idea that

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listening to Mozart makes people cleverer. Educators and politicians jumped on the bandwagon, but it is important to note that Shaw dissociates himself from many of the claims made under the umbrella of the Mozart effect (see the Preface of his book Keeping Mozart in Mind).

According to Campbell, the Mozart effect is: ‘the power of music to heal the body, strengthen the mind, and unlock the creative spirit’ (which actually is the subtitle of his book). It is clear from this definition that the powers attributed to music range far beyond intellectual enhancement. According to Campbell, listening to music can also cure physical ailments – in animals as well as in humans. Some of Campbell’s assertions, however, stretch credulity beyond breaking point, such as the claim that Beethoven’s music improves the rising of bread (Campbell, 1997, p.14). Even micro-organisms, it would seem, benefit from exposure to music.

The Mozart effect failed to replicate in a number of studies. In a meta-analytic study, published in Nature (1999, pp.826-7) Chabris reviewed 16 studies on the Mozart effect (with a total of 714 participants) and found that there was no effect whatsoever. Yet, the myth persists: a Google search makes over 250,000 hits. Amazon offers over 40 books with “Mozart Effect” in their titles.

The Morpheus effect

The brain does not work as a computer. Memory does not work as a video-camera. The brain is an organ of representation, no memory is stored unchanged. Little learning is possible without active attention to the stimuli. A form of putative learning without awareness has been explored using so-called subliminal learning or by exploiting the largely mythical capacity for learning while asleep. On these points over 15 years ago the British Psychological Society (*The Psychologist*, March 1992, p99) drew a very firm conclusion: “There is no evidence that people can learn while asleep. Learning can only occur if the sleeping person is partly awakened by the message”.

A related claim is that audiotapes with repeated suggestions played while asleep can help you to give up smoking, stop drinking, think creatively, increase confidence or make friends. Tapes are also available claiming to help you improve your memory through subliminal message. These have been shown to lead to people reporting that their memory is better. One very attractive study involved giving people audiotapes that were labelled to indicate that they were for memory improvement but in fact were tapes intended for enhancing self-esteem. This experiment is reminiscent of an episode of *Friends* (series 3, episode 18), whereby Chandler wishing to stop smoking borrows from her friend Rachel a stop-smoking tape, which allegedly acts during sleep. However, the tape was meant for women and kept stating that one could stop smoking being a strong and confident woman. This led Chandler to behave in a girly fashion.

The memory-enhancing tapes lead some people believing that their memory had improved, but when tested, their memory ability was no better than it was before (BPS Working Party Report, 1992). Having made the commitment and the financial investment, the simple belief that the purchased tapes might work can be sufficient to change your beliefs or even to change your habits.

In sum, understanding how the brain functions through the methods of science can be a creative endeavour; unsubstantiated beliefs are rather tedious and mind-numbing.

Further reading

Della Sala, S. (ed.) *Mind Myths: Exploring Popular Assumptions About the Mind and Brain.* Chichester: Wiley, 1999.

Della Sala, S. (ed.) *Tall Tales About The Mind & Brain. Separating Fact From Fiction.* Oxford: Oxford University Press, 2007.

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