In this month's edition of the newsletter we investigate the differences in brain structure between gender.

THINKING SKILLS PROGRAMME: NEWS

We are pleased to confirm that the Thinking Skills Programme will continue as a joint Cranfield University-MOD initiative for a further phase. The main activities will be to roll out personal development programmes over the next few months and to disseminate the products of the last two years. Karen Carr will be stepping down as she retires from Cranfield University, but the programme continues with the joint lead points of contact being Alison Wilken from MOD (AWilken.cmt@da.mod.uk) and Lorraine Dodd from Cranfield University (l.dodd@cranfield.ac.uk).

GENDER DIFFERENCES IN THE BRAIN

"Male brains are better at map reading. Female brains are better at multitasking". You may have heard such generalisations more than once, yet they are simply not true! There is no such thing as a 'male' or 'female' brain, and new research suggests that it is incorrect to even describe any characteristics of the brain as 'male' and 'female'. It is true that some characteristics of the brain are to be found more on average in females than males; and vice-versa for other. So any differences are quantitative rather than qualitative, and this means that differences between two women could be greater than differences between a man and a woman.

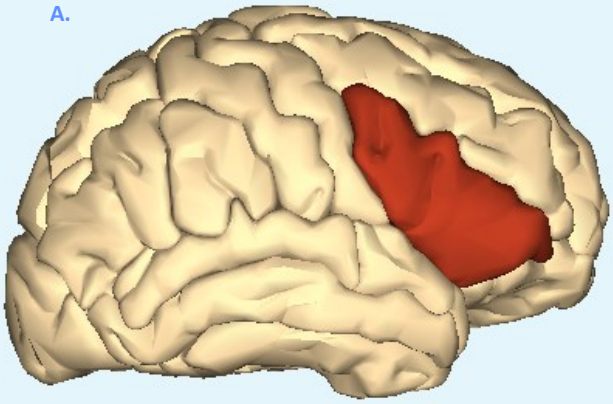
EVERYBODY IS DIFFERENT

A normal brain, male or female, will have the same fundamental set of features, but aspects of these features, such as size or responsiveness, will vary between individuals. This may not just be due to innate (inherited) differences but also to cultural, environmental and educational factors. The brain is very 'plastic' (i.e. it can adapt its structure and function) and this means that areas of the brain vary in size depending on use and skills. For example, London taxi drivers have a larger posterior hippocampus compared to other people (including bus drivers who have set bus routes). These taxi drivers also tend to have a smaller anterior hippocampus than others. The taxi drivers have developed enhanced navigational skills as they need to remember the street maps and layout of London. The posterior hippocampus is responsible for storing and recalling this spatial representation, hence it is enlarged compared to people that do not rely as much on spatial memory to navigate. This enlargement has a cost. The overall size of brain cannot increase once we are adult, as this would make things rather cramped inside the skull and the pressure on the brain would cause damage. So if some areas of the brain get larger, other areas that are not used so much need to get smaller. So although taxi drivers have a larger posterior hippocampus they have a smaller anterior hippocampus than non-taxi drivers to compensate. The anterior hippocampus is responsible for encoding new contextual information, the who, what, why, where of your personal experiences. A smaller anterior hippocampus may mean it can be difficult to recall new environmental layouts.

DIFFERENCES IN STRUCTURE

So what are the variations in brain characteristics between an 'average' male or female? The most obvious difference is not surprising, as men tend to be larger than women: men tend to have larger brains (averaged at 1.5Kg in weight compared to 1.3Kg of the average female brain). This difference in overall brain size makes it difficult to determine the nature of differences in individual features: what would a proportionate size or weight difference be? According to recent research, there are 29 features of the brain that generally differ in size between men and women, beyond any proportionate difference due to overall brain size. These include areas that convert short-term memory to long-term memory and other areas that play a role in risk aversion (Figure A. illustrates the area involved in risk aversion). This is consistent with evidence that women are better at remembering everyday life events and are less likely to engage in risky behaviour than men.

A.

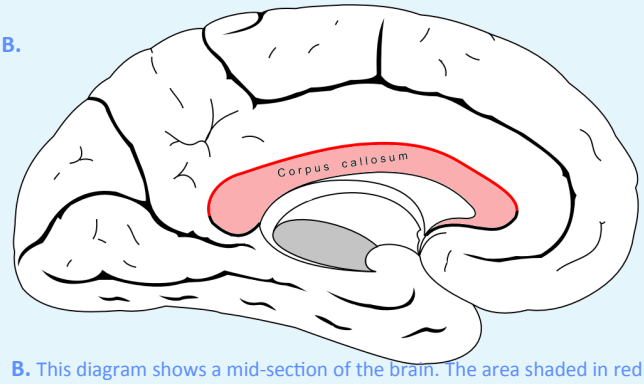


A. This diagram shows the outer surface (lateral view) of the right hemisphere of the brain, the area coloured red is the inferior frontal gyrus, involved in risk aversion.

There are some interesting differences in connectivity within the brain. The structure that connects the two hemispheres

(halves) of the brain together (see Figure B.) is on average proportionately larger in women: they have more connections between the two sides of the brain. In contrast, men generally have more connections between areas within each hemisphere. On average, men have more neurones (brain cells) than women, but women have more connections between the neurones. Connectivity is likely to help with forming associations between ideas and knowledge, so these differences in connectivity patterns could be associated with the ability to understand and to solve problems.

B.



B. This diagram shows a mid-section of the brain. The area shaded in red is the corpus callosum which connects the two hemispheres of the brain.

We all have the same neurochemicals (for example, hormones and neurotransmitters). But the concentrations of these chemicals vary between individuals. Males are more likely to have a higher concentration of testosterone than oestrogen in the body; in women this is the opposite with more women having higher oestrogen than testosterone levels. These hormone levels affect the brain in different ways. It has been found that testosterone enhances memory recall in most men and oestrogen enhances memory and learning recall in most women.

BRAIN MOSAIC

So what practical lessons can be inferred from this research? Our brains have a mosaic of features which vary in different ways. There is much commonality between the sexes in personality traits, attitudes, interests and behaviour. Although there may be some characteristics that you are more likely to inherit if you are male or female, the way in which you use your brain will have an important influence on development, and this could even outweigh some of those inherited characteristics. So, women and men have some distinctive mental characteristics that might be related to how they behave or perform in certain circumstances. However, this only holds true as a general description of the whole population of women and men, and there is considerable variability between all individuals. So if you wish to create a team that brings together a balance of these characteristics, rather than selecting a balance of men and women, it is much more important to select individuals. You may achieve your balance irrespective of the proportion of men and women.

REFERENCES

Hamzelou, J. (2015) Scans prove there's no such thing as a 'male' or 'female' brain. *New Scientist*

Joel, D. *et al.* (2015) Sex beyond the genitalia: The human brain mosaic. *PNAS* **112:**50:15468-73

Hyde, J.S. (2014) Gender Similarities and Differences. *Annu. Rev. Psychol.* **63:**373-98

A: Picture available at: https://commons.wikimedia.org/wiki/File:Gray727_sulcus_of_the_corpus_callosum.svg

B: Picture available at: https://commons.wikimedia.org/wiki/File:Cerebrum_-_inferior_frontal_gyrus_-_lateral_view.png

TEASER SECTION:

ANSWER TO NOVEMBER'S TEASER

Which four letter word connects all the following words?

DRY WISH BACK WHALE MEAL CHEEK

Answer: Bone. Bone-dry, wishbone, backbone, whalebone, bonemeal and cheekbone

THIS MONTH'S TEASER

Phil asked his friend Stan when his birthday is. Stan replies that he was 32 the day before yesterday and next year he'll be 35. When is his birthday and how is this possible?

Find the solution in next month's edition.

GOOD BOOKS AND JOURNALS

Mindfulness: a practical guide to finding peace in a Frantic world. By Mark Williams and Danny Penman. Helps to break the cycle of anxiety and stress as well as showing a way towards more successful thinking.

The Organised Mind. By Daniel J. Levitin. Trying to organise your conscious thinking for higher productivity and feeling less 'overloaded'.

Do No Harm. By Henry Marsh. Neurosurgeon Henry Marsh enlightens you into the world of neurosurgery with stories from his career.

Journal of Neuroscience of Consciousness. A new journal has been created by the Oxford University press, containing articles all about your conscious mind and the biology behind it.

CONTACT US:

If you've enjoyed reading this and wish to be added to the mailing list or have any general feedback, please feel free to contact us (defac-tsp-admin@defenceacademy.mod.uk)