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The Essential Difference: the male and female brain

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The field of sex differences in psychology is not new, though today it enjoys greater academic freedom than in past decades. The 1960s and 70s, whilst socially liberating, also made an open-minded debate about any possible role of biology contributing to psychological sex differences impossible. Those who explored the role of biology – even whilst acknowledging the importance of culture – found themselves accused of defending an essentialism that perpetuated inequalities between the sexes, and of oppression. Not a climate in which scientists can ask questions about mechanisms in nature. Today, the pendulum has settled sensibly in the middle of the nature-nurture debate, and scientists who care deeply about ending inequality and oppression can at the same time also talk freely about biological differences between the male and female brain and mind.

A new theory claims that the female brain is predominantly hard-wired for empathy, and that the male brain is predominantly hard-wired for understanding and building systems. It is known as the empathizing-systemizing (E-S) theory. Empathizing is the drive to identify another person's emotions and thoughts, and to respond to these with an appropriate emotion. The empathizer intuitively figures out how people are feeling, and how to treat people with care and sensitivity. Systemizing is the drive to analyse and explore a system, to extract underlying rules that govern the behaviour of a system; and the drive to construct systems. The systemizer intuitively figures out how things work, or what the underlying rules are controlling a system. Systems can be as varied as a pond, a vehicle, a computer, a plant, a library catalogue, a musical instrument, a math equation, or even an army unit. They all operate on inputs and deliver outputs, using rules.

According to this new theory, a person (whether male or female) has a particular 'brain type'. There are 3 common brain types: For some individuals, empathizing is stronger than systemizing. This is called a brain of type E, but we can also call it the female brain, because more females than males show this profile. For other individuals, systemizing is stronger than empathizing. This is called a brain of type S, but we can also call it the male brain, because more males than females show this profile. Yet other individuals are equally strong in their systemizing and empathizing. This is called the 'balanced brain', or a brain of type B. (Figure 1 illustrates these profiles diagrammatically).

The evidence for a female advantage in empathizing comes from many different areas. For example, given a free choice of which toys to play with, more girls than boys will play with dolls, enacting social and emotional themes. When children are put together to play with a little movie player that has only one eye-piece, overall boys tend to get more

of their fair share of looking down the eye piece. They just shoulder the other boys out of the way. Or if you leave out those big plastic cars that children can ride on, what you see is that more little boys play the 'ramming' game. They deliberately drive the vehicle into another child. The little girls ride around more carefully, avoiding the other children more often. This suggests the girls are being more sensitive to others.

Baby girls, as young as 12 months old, respond more empathically to the distress of other people, showing greater concern through more sad looks, sympathetic vocalizations and comforting. This echoes what you find in adulthood: more women report frequently sharing the emotional distress of their friends. Women also show more comforting than men do. When asked to judge when someone might have said something potentially hurtful – a *faux pas* – girls score higher from at least 7 years old. Women are also more sensitive to facial expressions. They are better at decoding non-verbal communication, picking up subtle nuances from tone of voice or facial expression, or judging a person's character.

There is also a sex difference in how aggression. Males tend to show far more 'direct' aggression (pushing, hitting, punching, etc.). Females tend to show more 'indirect' (or 'relational', covert) aggression. This includes things like gossip, exclusion, and bitchy remarks. It could be said that to punch someone in the face or to wound them physically requires an even lower level of empathy than a verbal snipe.

Two other ways to reveal a person's empathizing skill are to see how they (as a newcomer) join a group of strangers, and to see how they (as a host) react to a new person joining their group. This has been cleverly investigated in children by introducing a new boy or girl to a group who are already playing together. If the newcomer is female, she is more likely to stand and watch for a while, to check out what's going on, and then try to fit in with the ongoing activity. This usually leads to the newcomer being readily accepted into the group. If the newcomer is a boy, he is more likely to hijack the game by trying to change it, directing everyone's attention on to them. And even by the age of 6, girls are better at being a host. They are more attentive to the newcomer. Boys often just ignore the newcomer's attempt to join in. They are more likely to carry on with what they were already doing, perhaps preoccupied by their own interests.

How early are such sex differences in empathy evident? Certainly, by 12 months of age, girls make more eye contact than boys. But a study from Cambridge University shows that at birth, girls look longer at a face, and boys look longer at a suspended mechanical mobile. Furthermore, the Cambridge team found that how much eye contact children make is in part determined by a biological factor, prenatal testosterone. This has been demonstrated by measuring this hormone in amniotic fluid.

Boys, from toddlerhood onwards, are more interested in cars, trucks, planes, guns and swords, building blocks, constructional toys, and mechanical toys - systems. They seem to love putting things together, to build toy towers or towns or vehicles. Boys also enjoy playing with toys that have clear functions – buttons to press, things that will light up, or devices that will cause another object to move.

The same sort of pattern is seen in the adult work place. Some occupations are almost entirely male: Metal-working, weapon-making, crafting musical instruments, or the construction industries, such as boat-building. The focus of these occupations is on constructing systems. Professions such as maths, physics, and engineering, which require high systemizing, are also largely male-chosen disciplines.

Some psychological tests also show the male advantage in systemizing. For example, in the Mental Rotation Test, you're shown two shapes, and asked if one is a rotation or a mirror image of the other. Males are quicker and more accurate on this test. Reading maps has been used as another test of systemizing. Men can learn a route in fewer trials, just from looking at a map, correctly recalling more details about direction and distance. If you ask boys to make a map of an area that they have only visited once, their maps have a more accurate layout of the features in the environment, e.g., showing which landmark is southeast of another.

If you ask people to put together a 3-D mechanical apparatus in an assembly task, on average men score higher. Boys are also better at constructing block buildings from 2-D blueprints. These are constructional systems. The male preference for focusing on systems again is evident very early. The Cambridge study found that at one year old, little boys showed a stronger preference to watch a film of cars (mechanical systems), than a film of a person's face (with lots of emotional expression). Little girls showed the opposite preference. And at one day old, little boys look for longer at a mechanical mobile.

Culture and socialisation play a role in determining if you develop a male brain (stronger interest in systems) or female brain (stronger interest in empathy). But these studies of infancy strongly suggest that biology also partly determines this.

Some of the most convincing evidence for biological causes comes from studies of the effects of hormones. There was a time when women were prescribed a synthetic female hormone (diethylstilbestrol), in an attempt to prevent repeated spontaneous miscarriages. Boys born to such women are likely to show more female-typical, empathizing behaviours, such as caring for dolls. And if a female rat is injected at birth with testosterone, she shows faster, more accurate maze learning, compared to a female rat who has not been given such an injection. So masculinizing the rat hormonally improves her spatial systemizing.

Some important lessons have been learnt from studies of clinical conditions. Male babies born with IHH (idiopathic hypogonadotrophic hypogonadism) have very small testes (and therefore very low levels of testosterone) and they are worse at spatial aspects of systemizing, relative to normal males. Other male babies born with Androgen Insensitivity (AI) Syndrome (testosterone is an androgen) are also worse at systemizing. Compare these to female babies born with CAH (congenital adrenal hyperplasia), who have unusually high levels of androgens and who have enhanced spatial systemizing.

But even leaving aside these clinical conditions, there is evidence for the effects of hormones on the mind in the typical child: A Cambridge study found that toddlers who had lower foetal testosterone had higher levels of eye contact. Eye-contact may be related to sociability and empathizing. And a group of Canadian researchers found that the higher your prenatal testosterone the better you do on the Mental Rotation (systemizing) Test.

The E-S theory does not stereotype. Rather, it may help us explain why individuals are typical or atypical for their sex. It may help us understand the childhood neurological conditions of autism and Asperger Syndrome, which appear to be an extreme of the male brain. Such individuals may have impairments in empathizing alongside normal or even talented systemizing.

Earlier studies of psychological sex differences has focused on what is sometimes called 'the holy trinity': spatial ability, mathematical ability, and verbal ability. The first two of these are areas where males perform at a higher level, and the last of these typically shows a female advantage. However, spatial and mathematical abilities involve systemizing, and so may simply be further evidence for the E-S theory. Verbal ability may have nothing to do with empathy, in which case this will need to be regarded as an additional dimension along which the sexes differ psychologically. However, good empathizing and good verbal skills both facilitate communication, so that verbal and empathy skills may not be truly independent.

Key references:

Baron-Cohen, S. (2003) The Essential Difference: men, women and the extreme male brain (Penguin, Allen Lane/ Basic Books).

Kimura, D. (1997) Sex and Cognition. MIT Press/Bradford Books

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