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Brain, Sex and Ideology

Catherine Vidal

Does a sexual brain exist? There is no simple answer to this question. Indeed, the brain is the origin of thoughts and that makes it different from any other organ. As such, it is both a biological and a cultural organ. Lying behind the original question is the debate between nature and culture. And in this debate, science and ideology are closely linked (Vidal and Benoit-Browaeys, 2005). The topic of brain and sex is a perfect example of this: it concerns everybody and the media love the matter. This can be seen in the following headlines, which appeared recently in the press:

> 'Science proves that men and women think differently' (*International Herald Tribune*, March 1995)
>
> 'If I'm stupid, it's mummy's fault' (*le Figaro*, June 1997)
>
> 'Are homosexuals born that way?' (*Nouvel Observateur*, October 1995)
>
> 'Why do men never listen, why can't women read a map?' (A. B. Pease, *First Edition*, 1999)

These titles were all echoing articles published in the scientific press that tended to demonstrate differences between men's and women's brains, and also between heterosexuals' and homosexuals' brains. A sharp and methodical look at the data that are at the origin of these conclusions reveals how the reality of scientific facts can be far from their interpretation (Vidal, 2001a).

Brain volume, sex and intelligence

In the 19th century many studies tried to determine the possible link between brain size and intelligence in men and women (Gould, 1981). For years, Paul Broca, a French anatomist, worked on dead bodies, using two methods: one consisted of filling skulls with lead shot and weighing them to get an estimate of brain volume.

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The other method was to remove and weigh the brains. Broca found that men's brains were heavier by 181g compared to women's. He stated:

> One wonders whether the smaller size of women's brains is due to the small size of their bodies. But let's keep in mind that women are, on average, slightly less intelligent than men. Therefore one can conclude that the smaller brain of women is explained by their inferiority in both size and intelligence. (Broca, 1861)

However, at that time it was known, including by Broca himself, that brain size varies among individuals with age and body height. This was clearly demonstrated by the study of brains of famous writers and scientists who offered their body to science. For instance the brain of Anatole France weighed 1kg while that of Turgeniev weighed 2kg! But for Broca and his colleagues, ideology was stronger than scientific objectivity:

> On average, the brain mass is larger in men than in women, in clever men than in ordinary ones, and in superior races than in inferior ones . . . There is an obvious relationship between intelligence and brain volume. (Broca, 1861)

Even nowadays, the idea of linking intelligence and brain size is still alive. Lenin and Einstein's brains were weighed, sliced up and carefully studied. A research institute was dedicated to Lenin's brain. Nothing came out of this 'research' (see *La Recherche*, vol. 326, 1999). In 1992 the question of the link between IQ and brain size was once again debated in a paper submitted to the scientific journal *Nature*. This study was based on data coming from American army archives, relating to size of helmets and uniforms. The study showed that the skull size was larger in men than in women, in whites than in blacks and in officers compared to privates. Considering that the study was not 'politically correct', *Nature* refused to publish it (Maddox, 1992). Nevertheless the author managed to get it published in another international journal.

Brain and sexual reproduction

As far as biology is concerned, the brains of men and women are indeed different because sexual reproduction involves hormones and sexual behaviour controlled by the brain. At foetal stage the 'sexing' of the brain begins. At the beginning of the embryo's development the *genetic sex* – XX for women and XY for men – induces the formation of sexual organs, ovaries and testes. They start very early to produce sexual hormones, which are released in the blood of the foetus and so enter its brain. This early hormonal impregnation affects the formation of neuronal circuits that later in adulthood will be involved in the control of reproductive functions. This developmental programme is the same for all mammals: it is the result of evolution and indeed a necessary process for species survival.

Sex and cognitive functions

In 1982 a neuro-anatomical study showed that the *corpus callosum*, a bundle of fibres connecting the two cerebral hemispheres, was thicker in women than in men (Delacoste and Holloway, 1982). Consequently, women would have a better communication between the two hemispheres. This was supposed to explain a so-called capacity of women to perform various tasks simultaneously, which would not be the case for men. One should keep in mind that this statement was based upon a small sample of 20 brains described in the study. Since that time, thousands of brains have been examined. Statistically, no difference between men and women was found (Bishop and Wahlsten, 1997). In spite of this evidence, the story of the *corpus callosum* has a long-lasting life in the media.

Another attractive topic for the media is how differently men and women use their left and right brain (Geschwind and Galaburda, 1985). The left hemisphere would explain the 'better' ability of women with language, whereas men would be better in maths and spatial memory because of their right brain. Nowadays the original 'two brains theory' is no longer relevant, having been challenged by new experimental tools such as brain imaging. A new vision of the brain has emerged, since we can now see the brain at work. These new means of investigation have revealed that the two hemispheres never work independently. Moreover a given brain region can control various types of functions. Conversely a given function is never located in a single region. According to Broca's studies, it was thought that language was located in a specific area of the left hemisphere. Brain imaging has shown that at least ten different brain areas are devoted to language in both hemispheres. The same holds true for arithmetic calculation, which activates the frontal and posterior brain regions in both men and women (Dehaene et al., 1999).

The theory of the 'two brains' is also a long-lasting one. In the 1970s the theory was widely used by hippies in their quest for new spirituality. They put rationality and occidental values in the left brain, while the right brain was supposed to be the centre of affects, transcendental ideas and oriental values. This bipolar view of the brain, although out of date, is still attractive to the media.

Brain and homosexuality

In 1991 the American anatomist, Simon LeVay, published a study in the journal *Science* comparing the brains of men, women, and homosexual men. He found differences in the region of the *hypothalamus*, which is involved in the control of sexual hormones. Although the difference was rather small (one-tenth of a millimetre), LeVay did not hesitate to claim that he had found in the brain a biological substrate of homosexuality.

It should be stressed that this opinion is far from being shared by the scientific community, not only because of its ideological implications but especially because the experimental data are not convincing (Vidal, 1996). Indeed, all the homosexual men studied had died from AIDS. This point is a major bias in the study as the AIDS virus may invade the brain, causing important lesions. Thus, comparing AIDS virus

infected brains with other brains is not valid, and it is not very surprising that other scientists have never replicated LeVay's findings. Moreover, how could one-tenth of a millimetre of brain determine homosexuality, when we know that sexual orientation might vary according to each individual's life?

Up to now there is no scientific evidence that brain, hormones or genes cause homosexuality. Some ten years ago, a researcher claimed to have found a gene for homosexuality (Hamer et al., 1993). Since then these findings have been disproved (Rice, 1999), but the media made a successful story out of it and people keep on believing that this gene exists.

It is important to point out that the above studies were published in *Nature* and *Science* in spite of their lack of rigorous data. This is becoming the trend for topics like brain, sex and behaviour, which are important issues for the media.

Brain plasticity and cognitive functions

For fifteen years or so brain imaging studies have led to spectacular progress in our knowledge of the brain. It is important to stress that out of more than a thousand studies on higher cognitive functions, only a few dozen have shown differences between men and women. The main reason is that our brains are all different. For instance, if you look at the brains of several subjects performing the same mental calculation, it appears that no one uses their brain in the same way (Vidal, 2001b). Thus brain variability between individuals exceeds variability between men and women, which is therefore the exception.

The origin of such variability is a fundamental question. Is it innate or is it acquired? Much progress has been made in understanding the role of genes and environmental factors in the building of the brain. The human brain is made of 100 billion neurones, which form circuits and communicate by means of a million billion synapses. On average, each neurone is connected to 10,000 others. These figures are astronomical compared to the 6000 genes present in the brain. This means that there are not enough genes to control the formation of the billions of synapses. What is the function of these genes? They play a key role during the development of the embryo. They set up the basis of the brain's anatomy: they control the formation of the hemispheres, the cerebellum, the brainstem, etc. At birth, the main lines of the brain's architecture are defined, and the neurones stop multiplying.

However, the brain is far from complete: 90 percent of the synapses will be built gradually after birth. In this process, the environment plays a major role, including both 'internal' factors (hormones, nutrition, diseases . . .) and 'external' influences (family, education, social interactions). We talk of 'plasticity' to describe this ability of the brain to shape itself according to life experience.

Brain imaging clearly demonstrates this. An experiment carried out with violinists has shown that the brain region that controls the left hand is much larger than the region controlling the right hand (Elbert et al., 1995). This result is explained by the fact that the fingers of left hand are far more active on the violin neck, unlike those of right hand, which hold the bow. Moreover, this increase in brain surface is greater if the future violinist has started to practise early in life, i.e. between the ages

of 5 and 10, when brain plasticity is particularly high. But this does not mean that children who start playing later will not get the chance to become good musicians. Their brains will simply use other strategies for learning.

The plasticity process also goes on in adults through experience and learning. A brain imaging study on taxi-drivers has revealed an expansion of brain regions controlling spatial representation (Maguire et al., 2000). In addition, the increase in surface is proportional to the number of years of taxi-driving practice.

These results demonstrate how experience in life influences brain functions. Our personal history is thus carved in our brains throughout our lives. As a result, no one has exactly the same brain, not even identical twins.

Psychology and sex

These arguments taken together provide strong evidence for the major role played by sociocultural factors in differentiating cognitive aptitudes between men and women. Nevertheless, the opposite position is still favoured by some scientific circles, particularly in the USA and Canada (see Fausto-Sterling, 1992). They claim that innate differences in mental capacity between men and women determine their social and professional representation. For instance, they consider that there is no point in encouraging women to study science and maths: they do not choose these topics because their natural tendency does not push them (Kimura, 1999).

Most of the arguments behind these deterministic ideas are based upon psychological tests. Women are generally better at languages, while men show better performance in spatial orientation (Kimura, 1999). What conclusions can we draw from these tests? First of all, one should bear in mind that demonstrating sex differences does not provide clues to determining the origin of these differences. Are they innate or acquired? Concerning verbal, spatial and mathematical aptitudes, a number of arguments do not support the innate origin. First, sex differences are detected from adolescence and not before. Moreover, they gradually disappear after a few days' training in performing the tests. They have also been reported to be more marked in whites than in other ethnic communities (black, Asian), thus showing the influence of cultural environment. This point has been stressed by sociological studies on the role of upbringing. In our western societies young boys are often trained in outdoor sports such as soccer, for which they need to acquire skills in spatial orientation. As described above, such an early training can influence brain development and induce the formation of neuronal circuits involved in spatial orientation. This ability would be less likely in young girls, who stay at home more, a situation that favours the use of language to communicate. Finally, a compilation of psychological tests published in the last 20 years shows a progressive reduction in sex differences, concomitant with women's increased integration into social and professional life (Feingold, 1988).

Genetics and sex

The development of genetics has brought new opportunities to the supporters of innate behavioural differences between men and women. A good example is the discovery of the 'gene of marital fidelity' found in wild rodents, specifically voles. There are two species of vole, living in different natural environments. The prairie voles are monogamous and stay in the nest with their offspring. In contrast, male voles living in mountains are polygamous and run away from the nest. American scientists put these voles in a laboratory to study their brains and their genes (Young et al., 1999). They found differences between the two species in some brain areas which control the action of the hormone vasopressin. So they wondered whether vasopressin injected into the vole's brain could influence fidelity behaviour. But how to measure fidelity in a laboratory? The researchers designed a test with two cages linked by a tunnel. In one cage was a female vole that had been previously anaesthetized to prevent any risk of sexual attraction. A male vole was placed in the other cage, just after having received an intra-cerebral injection of vasopressin. What happened when the tunnel door was opened? The promiscuous mountain vole sniffed the female for one minute and then lost interest. In contrast, when it was the turn of the faithful prairie vole, the sniffing lasted for two minutes. Thus the authors concluded that one minute's sniffing difference was evidence that fidelity behaviour was linked to the genetic code for vasopressin! Obviously such interpretation is far beyond the experimental data. Nevertheless the paper was accepted for publication by *Nature*. But circumstances were favourable: this happened in 1999, at the time of the Clinton–Lewinsky case. It was thus easy to excuse the President, who simply lacked the good gene!

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In the 19th century, the size of the brain was used to justify the hierarchy between men and women, races and social classes. Nowadays, brain imaging and genetics have led to important progress in our understanding of the fascinating complexity of the human brain. However, the ideology of biological determinism is still alive. The use of biology as a tool to account for social hierarchy is still a major threat. This concept erases sociocultural and political factors from any consideration of what creates major inequalities between men and women.

The persistence of deterministic ideas is fed by the ambiguous intricacy between society and science. Why do some scientists keep on promoting it, and in North America more than in Europe? Why do the famous scientific journals *Nature* and *Science* contribute to the support of these ideas? Why do feminist movements, which 20 years ago rejected the idea of biological differences between men and women, accept it today and use it to justify their claims?

The answers to these questions are closely related to the recent boom in biology and biotechnologies. The trend is to reduce both body and mind to a bunch of neurones, genes and molecules. The same is true for gender, which is reduced to biological sex. The threat is that so-called biological evidence could conveniently

justify racism and sexism. It is the responsibility of scientists and citizens to stand against the misuse of science for ideological purposes.

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