*Koczogh Helga Vanda: Verbal Superiority of Women*
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# Verbal Superiority of Women?

**Abstract**

In this article my aim is to scrutinise the merits of the verbal superiority of women with the help of prevalent studies as well as to identify the possible causes. First, I wish to talk about the stereotypes of women in terms of verbosity, then I am going to examine the sex differences in brain structure and their consequences. I also introduce the sex-specific differences in cognitive functions highlighting the possible causes, using the findings of studies on healthy and damaged brains. Finally, I am going to shed some light on other factors that may contribute to the sex differences in cognitive functions. I propose that the widespread stereotype on female talkativeness is unfounded and the verbal superiority of women as such is non-existent. Certainly, there are sex-specific differences between men and women and these, according to my impression, are influenced by the interplay of both biology and cultural learning. I am also going to reveal that although there exist some consensus of researchers regarding the gender differences in language use, many of the findings show inconsistency.

## 1 Stereotypes of women

### *1.1 Myth or reality?*

Gender differences in conversational habits have been a favoured subject matter of scientists, researchers and lay people for a long time. The stereotype of chatty, talkative women is so prevalent that even scientists have long presumed that females speak more than men, moreover they have used this assumption as a scientific fact. The 'female chatterbox' stereotype can be found in many cultures as demonstrated by the following proverbs:

Wherever there are women there's talking, wherever there's a geese there's cackling. (Ireland)
The tongues of women increase by all that they take from their feet. (China)
He who doesn't like chattering women must stay a bachelor. (Congo)
Women only keep quiet about their age. (Germany)
If you have five wives, then you have five tongues. (Africa)
A woman would rather swallow her teeth than her tongue. (France)
Choose a wife rather by your ear than by your eye. (England)
Women never praise without gossipping. (China)
There is nothing sharper than a woman's tongue. (Ireland)
The only sword that never rests is the tongue of a woman. (China)
Foxes are all tail, and women are all tongue. (England)
A woman's tongue cracks bones. (Malta) (www.creativeproverbs.com)

It is apparent that women are the victims of malicious proverbs in a lot of languages. However, I think not only women are disadvantaged by this popular myth, but men as well, because it suggests to males that "silence is golden" and in order to be a good man, they should not talk. So this stereotype puts constraints on both sexes and it should be dispelled unless it is founded scientifically. In the following subsection I am going to put the question whether women are really more verbose than men under scrutiny.

### *1.2 Who talks more: fact-checking*

Since the early '90s a series of books and articles have claimed that women talk much more than men do. The data varies from researcher to researcher, but most of them assert that the male daily word budget ranges from 2,000 to 25,000 compared with 7,000 and 50,000 for women. However, none of the authors indicate where their data comes from.

Sometimes there seems to be no agreement about the figures among the various works of a single author either. Allan Pease, for example, declares in *Why Men Don't Listen and Women Can't Read Maps* that a woman uses about 6,000-8,000 words, 2,000-3,000 vocal sounds and 8,000-10,000 facial expressions, head movements, and other body language signals per day, while a man uses just 2,000-4,000, 1,000-2,000, 2,000-3,000 respectively (Pease, 2000: 81). But he does not provide the source of any of the counts. However, four years later in a CNN interview (available at http://transcripts.cnn.com/ TRANSCRIPTS/0402/14/smn. 01.html) he said that "women can speak 20,000 to 24,000 words a day versus a man's top end of 7,000 to 10,000."

The common belief that women are a lot more talkative than men was reinforced with the first publication of the book titled *The Female Brain* in 2006. Its author, Dr. Louann Brizendine, a neuropsychiatrist and the director of one of the world's most prominent biomedical research institutions wrote that women utter an average of 20,000 words a day, whereas men utter 7,000. Later she had to disavow the data, as she could not back it up.

In the very same book she also claims that women speak twice as fast per minute as men, again without apparent empirical support. By contrast, a research carried out on the speaking rate of English and Chinese telephone conversations by Mark Liberman et al. showed that "the males spoke about two percent faster, on average, than the females" (Liberman 2006).

Until that year no one had ever recorded the total daily output of a sizable number of people in natural conversations. Earlier studies normally recorded people in unnatural settings, such as in labs. As a consequence, the data needed to accurately estimate differences in the daily word usage of the two sexes was not given. Based on tape-recorded conversations from 153 participants from the British National Corpus, Liberman (2006) calculates that women speak 8,805 and men 6,073 words per day. "However, he acknowledged that these estimates may be problematic because no information was available regarding when participants decided to turn off their manual tape recorders" (Mehl et al. 2007: 82). Taking everything into account 6,073 vs. 8,805 is still a far cry from 7,000 vs. 20,000.

Matthias R. Mehl et al. and his fellow researchers have developed a method for getting access to natural language use. They equipped 396 college students (345 Americans and 51 Mexicans) with devices that automatically recorded half a minute of their speech every 12.5 minutes. The advantages of this equipment are that it cannot be controlled by the participants, not even be sensed when it is on or off. The astonishing results based on six samples are shown in the following condensed table (Mehl et al. 2007: 82):

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| Sample | Age range (years) | Sample size (N) | | Estimated average number of words per day | |
|---|---|---|---|---|---|
| | | Women | Men | Women | Men |
| 1 | 18-29 | 56 | 56 | 18,443 (7460) | 16,576 (7871) |
| 2 | 17-23 | 42 | 37 | 14,297 (6441) | 14,060 (9065) |
| 3 | 17-25 | 31 | 20 | 14,704 (6215) | 15,022 (7864) |
| 4 | 17-22 | 47 | 49 | 16,177 (7520) | 16,569 (9108) |
| 5 | 18-26 | 7 | 4 | 15,761 (8985) | 24,051 (10,211) |
| 6 | 17-23 | 27 | 20 | 16,496 (7914) | 12,867 (8343) |
| | | **Weighted average** | | 16,215 (7301) | 15,669 (8633) |

*Table 1. Estimated number of words spoken per day for female and male study participants across six samples.*

As the data suggests, the researchers found that women speak little more than 16,000 words and men speak a little less than 16,000 words a day. The difference (546 words) is statistically insignificant. One potential drawback of this study is that the subjects recorded were from a very similar age group and educational background. This can be an explanation for the homogeneity of the samples. Yet the figures did not back the assumption that women have a larger daily word budget than men (Mehl et al. 2007).

One of the most comprehensive studies carried out by Campbell Leaper and Melanie Ayres, who have surveyed seventy studies on gender differences in talkativeness, counting the words per speaking turn supports the previous figures as well. It reveals that, contrary to prediction, men are significantly more talkative than women. This finding also contradicts the popular stereotype that women are more verbose than men. In view of these results we can claim that the widespread stereotype on female talkativeness is unfounded (Leaper 2007).

As Deborah Tannen (2007) pointed out, men talk more in public contexts such as meetings, so the verbosity of the sexes depends largely on the setting of the discourse. Also, we have to take into consideration the individual differences, since we can easily find women who talk much less than their female peers and men who tend to talk all the time. Therefore we have to be aware of the fact that whatever the average female vs. male difference is, it will change from one social setting to another and it will be partly due to the variation among individuals, too.

## 2 Men and women: different brains?

### *2.1 Sex differences in brain structure: introduction*

Apart from external anatomical sexual differences, there are numerous other differences between men and women in terms of the structure, chemistry and function of the brain. These, among many other factors, account for their sex-specific skills and behaviour. So the idea of a unisex brain is a myth. Men and women share 99% of their DNA, but that 1% makes a huge difference.

Several studies suggest that while there are many similarities in the brain structure of healthy men and women, there are important differences that distinguish the male from the female brain. In the following subsections I intend to give a short overview of the main structural differences between the brains of the two sexes and pinpoint their significance. I would

like to highlight that there is a high variability between individuals in these studies. The variability may result from biological and environmental influences as well.

### *2.2 Brain volumes*

There is growing interest in sex differences in the human brain, because of the common beliefs about gender differences in cognitive abilities, namely better verbal skills in women and better spatial abilities in men. Hence, size differences in particular parts of the human brain seem to be of vital importance.

According to Kimura (1999) men have 10-15% bigger and heavier brains than women, which is explained in part by their bigger stature. But is this really so? Ankney has examined the brain volume of men and women of similar height and weight and pointed out that a male's brain volume is about 100 g bigger (Kimura 1999). Allen et al. (1991) have reported that the proportional sizes of individual regions in relation to total hemisphere volume were similar in both sexes. Due to the greater brain volume, men are claimed to be more intelligent than women, although this assumption is disputed by researchers like Kimura (1999) or Tannen (2006). So there is a lack of consistency in the findings relative to different brain volumes of men and women.

Similarly to brain volume, gray and white matter volumes vary by sex as well. Women have a higher percentage of gray matter, whereas men have a higher percentage of white matter (Gur et al. 1999). Again there are some studies that contradict these findings. For example, some researchers have detected that there is no sex difference regarding the brain size in total gray matter volume and some other studies even reported greater gray matter volume in men versus women (Cosgrove et al. 2007). For instance, psychology professor Richard Haifer's findings show that "men have nearly 6.5 times the amount of gray matter related to general intelligence compared with women, whereas women have nearly 10 times the amount of white matter related to intelligence compared to men" (Carey 2005). The outcome of this study may aid the understanding of why males and females naturally tend to be better at different types of tasks, such as math and verbal skills.

On the whole we can state that men's brains are larger, but regional volume differences are not so consistent. Also, there are gender differences in terms of gray matter and white matter volume. And an interesting fact confirmed postmortem: although men have a greater brain volume, as they age, it also shrinks faster than women's brains (Cosgrove et al. 2007).

### *2.3 Sexual dimorphism in the corpus callosum*

The corpus callosum is the white matter of millions of nerve cells that connect the left and right hemispheres of the brain. The significance of its difference in size in men vs women is highly disputed. It has been assumed that the posterior portion of the human corpus callosum (called the splenium) is larger in women than in men. It is argued that since the corpus callosum is a channel for communication between the left and the right hemispheres of the brain, its larger size in women makes the hemispheres communicate more often and faster than in men. According to Time magazine this "greater crosstalk between the hemispheres might explain enigmatic phenomena like female intuition" (Gorman 1992).

Post-mortem studies carried out up to the beginning of the 20th century indicate that the average size of males' corpus callosum is larger than that of the other sex. In their report *Sexual Dimorphism in the Human Corpus Callosum* (1982) Christine De Lacoste-Utamsing

and Ralph L. Holloway examined some brains and discovered that the female brains had, on average, corpus callosa with larger splenia. Although they noted that the relative small size of their sample could be a potential drawback of their research and could question the findings. Naturally, the findings they took from a small sample size became the catalyst for further research.

Studies since that time have not consistently replicated the results. Some have even contradicted them. A significant 1990 review paper carried out a meta-analysis of 49 studies published since 1980 and found, contrary to de Lacoste-Utamsing and Holloway, that there is no significant sex difference in the size of the corpus callosum. The authors of the study conclude that the "widespread belief that women have a larger splenium than men and consequently think differently is untenable" (Bishop & Wahlsten 1997: 581).

Yet another study performed by Allen, Richey, Chai, and Gorski has concluded that there is a dramatic sex difference in the shape of the corpus callosum. According to them the splenium is more bulbous shaped in females than in males. Also they support the original claim about the size of corpus callosum in women by having observed that the width of the splenium is significantly greater (up to 23%) in women than in men. They have also measured thicker connections between the two hemispheres in other parts of women's brains (Gorman 1992). As they see it, "these anatomical sex differences could, in part, underlie gender-related differences in behaviour and neuropsychological function" (Allen et al. 1991: 933).

More recent studies, most of which used magnetic resonance imaging (MRI), confirm the earlier findings of larger average brain size and overall corpus callosum size for males. To what extent these morphological differences are associated with behavioural and cognitive differences between the two sexes is still unclear. In the light of these research findings I conclude that the evidence for gender differences in the corpus callosum is inconclusive.

## 3 Verbal superiority of women

### *3.1 Introduction*

After having looked at the structural dimorphism of the brain, in this section I intend to focus on some of the behavioural and cognitive differences between girls and boys, men and women. Encouraged by the discovery of structural differences of the brains, a number of researchers have begun looking for dichotomies of function as well. Sex differences in cognition are consistently reported, men excelling in most visuospatial tasks and women in certain verbal tasks. It has been hypothesized that these sex differences in cognition are partly due to the structural differences between the brains of males and females.

### *3.2 Boys vs girls*

It is apparent that girls do better than boys at a variety of verbal skills (Kimura 1999). For instance, girls start speaking earlier than boys, use complex grammatical constructions sooner and their speech is almost completely comprehensible. In contrast, boys use fillers like "uh", "um", and "like" during conversation, and they are more likely to drop the *g* from the end of words. At the age of three girls have twice the vocabulary of boys of the same age. Also, boys use only three tones of voice when speaking, compared to a girl's five tones (ibid.).

Girls learn foreign languages faster and easier than boys, and they excel at grammar, punctuation, spelling, and literature. In the beginning, boys don't do well at school because

their verbal abilities are inferior to those of girls. As a result, they perform poorly in foreign languages, English grammar and spelling, and the arts. Later, girls fall behind in physics and sciences where spatial ability is essential, and when boys catch up due to their improved verbal skills. After puberty the gap between boys and girls on verbal tasks widens again (Pease 2000).

In addition, logopedic problems are most characteristic of boys. Stuttering, for instance, is a speech defect almost entirely restricted to males. Similarly, according to Stein and Walsh (1997) "the incidence of developmental dyslexia, which often accompanies impairment in phonological processing of speech sounds, is three to four times higher in boys" (Kansaku & Kitazawa 2001: 336).

So there seems to be a consensus on the superiority of girls over boys in certain verbal skills up to the early schoolyears.

## *3.3 Men vs women*

### *3.3.1 Misconceptions*

Many people have the impression that women's verbal skills are better than those of men. In adulthood, however, women have neither larger vocabularies (but their more extended colour vocabulary is confirmed) nor higher verbal intelligence than men, although they do appear to be better spellers (Kimura 1999). They have been found to be superior at verbal fluency, speech articulation, grammatical skills, and the use of more complex and longer sentences, too.

It also holds true that there are more female teachers than male, and women dominate subjects where strong verbal ability is required such as literature and languages. In Britain in 1998, for example, more than 70% of the foreign language teachers were female. There also appears to be many more female interpreters in the world than male (Pease 2000).

I have to mention here that some of the sex differences on verbal tasks are small, while others are large. Females outperform men in certain speech tasks such as speed of articulation, accuracy of speech production and fluency, but this advantage has not been found in other areas of language use, such as verbal reasoning or comprehension (Weiss et al. 2003).

### *3.3.2 Verbal fluency*

To most people the word 'fluency' implies the easiness of producing coherent sentences. In this article, however, I am going to use this term to refer to timed tasks in which subjects need to produce words or sentences with particular constrains on them. For instance, the task may restrict the specific letter(s) the word should begin or end with.

Women and girls have frequently been shown to surpass men and boys on a variety of verbal tasks, including verbal fluency. A few years ago Leslie A. Burton and his colleagues carried out some research in which 134 university students (93 female, 41 male) were administered the so-called Thurstone Written Verbal Fluency Test. The task was to write as many words in 5 minutes as the participant could that begin with the letter *s*, then to write four-letter words that begin with *c* in 4 minutes. Gender differences were found in the expected directions, such that the women highly outperformed men in this task (Burton, Henninger & Hafetz 2005).

In recent years another verbal fluency test has been conducted by Weiss et al. (2003) which also reinforced the results of the above mentioned study. 97 university students partici-

pated in it and their verbal fluency was tested in two ways. In the lexical word fluency test, they had one minute per letter to write all the words they knew that begin with *b*, *a*, and *s*. In the category fluency test, the subjects were given a category and were asked to write down all the words belonging to the categories 'supermarket', 'animals', and 'vegetables'. This test was also timed at one minute per trial. The results showed consistency with the previous one, as women performed at a significantly higher level than men on these tasks (Weiss et al. 2003). According to Kimura women's better fluency might be explained by better brain representation for the phonemes. This may also account for young girls' better articulation and spelling, which are also continued in adulthood (Kimura 1999).

### *3.3.3 Verbal memory and verbal intelligence*

Although it has been reported that men and women do not differ in general intelligence, sex differences in specific cognitive abilities have been identified. There are gender differences in memory, although the findings are not always consistent. Some studies have pointed out that there is an advantage for women in verbal memory tests over men. It has also been found that females outperform males on certain memory tasks such as word recall, word recognition, story recall, face and name recall and recognition (Weiss et al. 2003).

Kimura tested both incidental (you are not told in advance that you will have to remember a series of sounds, words, etc.) and intentional verbal memory (you are told in advance the you will have to remember a series of items) and she concluded that women perform a lot better on intentional verbal memory tasks than men, and they also surpass men on tasks of incidental verbal memory (Kimura 1999). She also shed some light on the fact that previous studies claiming a female advantage on tasks of incidental memory used tasks that were heavily verbal in nature. Thus, according to Kimura, the performance of women on these tasks may have been thanks to their superior verbal skills.

Chipman and Kimura made a series of studies and they observed a female superiority on both incidental and intentional tasks of verbal memory. However, no sex difference was found when incidental memory was tested using two pictorial tasks. Consequently, the female advantage on previous verbal tasks of incidental memory may have been due to the use of verbal stimuli. Their better result on these tests could be caused by the fact, i.e., that they outperform men on measures of verbal rote memory (Chipman & Kimura 1998).

Weiss et al. measured verbal memory with two tests where subjects were first required to recall words they had been introduced to 20 minutes earlier, then to listen to a short passage of prose and write down as much of it as they could immediately afterwards and again after a delay. The results of these tests did not replicate the previous ones in this field. Similarly to Kimura, Weiss et al. found a female advantage on word recognition memory, but – contrary to previous studies – they did not find any gender differences on the story recall memory test (Weiss et al. 2003).

Weiss et al. also measured verbal intelligence using the Mehrfachwahl-Wortschatz-Test (Lehrl 1989), which is "a multiple choice vocabulary intelligence test to assess crystallized intelligence", for this purpose (Weiss et al. 2003: 866). The results showed that the male students had a higher verbal IQ, although this can be due to the fact that they were significantly older. As mentioned in section 3.3.1, according to Kimura women and men do not differ in terms of verbal intelligence.

On the whole we can state that researchers agree on the verbal superiority of girls over boys in certain verbal tasks, but no such consensus exists with regard to the better verbal

skills of women over men. The majority of past studies support the hypothesis that women surpass men on certain verbal tasks such as verbal fluency and spelling while men have higher verbal intelligence. However, the results in connection with the better verbal memory of women are unsettled.

## 4 Causes of sex differences in cognitive functions

### *4.1 Lateralisation*

It has been proved that the cerebral hemispheres of the human brain differ in structure primarily in terms of motor control: the right hemisphere controls the left half of the body, while the left hemisphere controls the right half of the body. Moreover, Paul Broca spread out the theory of lateralisation with the discovery of the so-called Broca's area in the left hemisphere in 1861. He observed that this area named after him is involved in language processing, speech production, and comprehension. In 1974, Wernicke's area – a part of the right hemisphere responsible for understanding the written word – was discovered (O'Grady et. al. 1996).

These two discoveries have inspired a number of studies attempting to reveal other functional differences between the two hemispheres. Researchers have started to investigate to what extent areas of the brain are specialised for certain functions. In short, the left hemisphere is believed to be responsible for the language functions as well as the general cognitive functions. In contrast, nonverbal processes like the detection of complicated auditory tones, and functions such as holistic reasoning, spatial manipulation, the transfer of visual and musical stimuli are lateralized to the right hemisphere. It is important to note that these lateralisations are trends and do not apply to every person (ibid.). Even though the two hemispheres have different functions they do not work independently of each other: they communicate with each other via the corpus callosum.

### *4.2 Investigating the healthy brain*

It has been hypothesised that the sex differences in cognition result from the assumption that language is more laterized in men than in women (Kimura 1999). Language representation in the female brain is claimed to be more bilateral than in the male brain. Hence, women might use both hemispheres for language functions whereas men primarily use the left hemisphere.

Studying hemispheric differences in terms of laterization is possible with the help of neuroimaging techniques such as magnetic resonance imaging (MRI) and positron emission tomography (PET) scans in conjunction with language tests. These techniques aid the advanced analysis of the functions of the two hemispheres in living healthy people. The results of these studies are not consistent. Attempting to summarise the great number of studies on sex differences in the laterization of language K. Kansaku and S. Kitazawa (2001: 334) propose that:

> […] during word language tasks, sex differences were found in the inferior frontal gyrus when the subjects performed phonological (Shaywitz et al. 1995; Pugh et al. 1996) or syntax (Jaeger et al. 1998) tasks that could be applied to nonsense words. On the other hand, no sex differences were observed when the subjects were given word language tasks that were intrinsically semantic and applied exclusively to real words, not to nonsense words.

They tested sex differences in passive listening to stories as well and they took functional magnetic resonance imaging (fMRI) scans while the subjects were listening to an essay read aloud, then to the same story played in reverse. Both hemispheres were active in women contrary to men while listening to the essay. However, laterazition was shown to the left hemisphere in men when the story was played in the reverse, but not in women. Of course, bilateral activation in the female brain while listening to stories does not mean that women have better comprehension skills. No significant relationship was found between the degree of lateralisation and the number of correct answers on the post-listening tasks (Kansaku & Kitazawa 2001).

Kansaku and Kitazawa also concluded that the sex difference was specific for global semantic structure. This may be because of the bigger corpus callosum in the female brain. It is likely that the larger size of this area promotes more effective communication between the hemispheres and thus allows women to process sentences bilaterally and maybe even more quickly.

To test the validity of more bilateral language representation in women, a meta-analysis was carried out by Sommer et al. in 2004 on studies that measured language activity with functional imaging in healthy men and women. Out of the selected 24 studies measuring language laterization with fMRI – performed between 1995 and 2004 – 14 were included, providing data on 377 men and 442 women. The results showed no significant difference between males and females in terms of language lateralisation. Also, the majority of the 24 studies reported no difference in lateralisation between men and women. Those that did usually worked with smaller sample sizes. In the light of these findings Sommer et al. proposes the null hypothesis:

> […] there is no sex difference in language laterization at the population level. If this hypothesis were true, the sex differences reported in the studies with small samples may reflect biased reporting of chance findings… This hypothesis offers an explanation for the larger mean sample size of studies with negative findings compared with positive findings (2004: 1848).

Apart from MRI, fMRI and PET scans there is another and less costly method that helps to analyse the function of the two hemispheres in healthy living people. It is called the Wada test (named after a neurologist, Juhn A. Wada) and it involves injectioning an anaesthetic into one of the hemispheres of the brain. This injection stops the functions of the anaesthetized hemisphere for a few minutes. Once it is done, the doctor can perform language tests on the functioning hemisphere to determine dominance for such functions as language production and comprehension, verbal memory and verbal fluency. It has been shown that the verbal fluency of women got worse when either of the hemispheres were anaesthetised, while men's performance worsened in the case of left hemisphere anaesthetisation. This also supports the bilateral language representation theory in women (Baron-Cohen 2006).

It is apparent that there is no consensus on the gender differences in language representation in healthy men and women. In the following subsection my aim is to find sex-specific differences in terms of language lateralisation with the help of studies on people with brain injuries.

In the next section of my article I will introduce some studies that investigated the causes that might trigger sex differences in cognitive functions. These mostly deal with the concept of lateralisation and attempt to find the influencing factors either by examining healthy or damaged brains.

### *4.3 Investigating the damaged brain*

The assumption that sex differences in cognition are caused by more bilateral representation of language in females than in males is supported by several findings. The strongest evidence for this theory emerges from studies of brain-damaged humans. Damage to one brain hemisphere sometimes causes less harm in a woman than the same injury in a man does. It has been reported that men have a higher occurrence of aphasia (impairment of the power to produce and understand speech) after injuries to the left hemisphere (48% in males vs. 13% in females), while women patients incur verbal impairment less frequently when the same area is injured. As quoted in Baxter, McGlone also found that females suffer from language deficits only in case of both right and left hemisphere damage (Baxter et al. 2003). Perhaps this is attributable to the assumption that language is represented bilaterally in women and if one hemisphere is damaged the other can still process language properly.

Kimura replicated Mc Glone's finding of a higher incidence of aphasia after left-hemisphere lesion in a sample of 144 men and 92 women. However, she found that contrary to previous findings, there were no sex differences in the incidence of aphasia after damage to the right hemisphere. Kimura also observed that women have aphasia more frequently after anterior injury than after posterior injury to the brain. However, posterior damage is more likely to cause language deficits in men (Kimura 1999, 2002). It is shown that anterior damage occurs less frequently than posterior damage, and this can be a reason for the rarer incidence of aphasia in women after left hemisphere lesions.

Kimura studied the effects of brain injuries on different verbal tasks and she discovered that the results of the vocabulary test and a verbal fluency test were affected by left hemisphere damage in men, while slight effects were detected in case of either hemisphere injury in women. Thus, it is suggested that women use both of the hemispheres more equally when using abstract verbal skills than men do. However, this does not apply to all the word-related tasks, as verbal memory depends on the left hemisphere in both women and men (Kimura 2002). In this task women's and men's scores are bad in case of a left hemisphere lesion, but women still outdo men (Kimura 1999).

Challenging the previous findings, Kertesz and Sheppard have reported that women who had suffered left hemisphere stroke scored somewhat worse on the Western Aphasia Battery than men with similar injuries. In case of a right hemisphere stroke there were no sex differences between males and females on this test. Hence, the results of sex-specific differences after a stroke in the left hemisphere are again inconsistent. Similarly, differences in aphasia after right hemisphere damage have not been displayed (Sommer et al. 2004).

A number of researchers see the key to sex differences in cognitive functions in language laterization, however, the findings are conflicting.

## 5 Other factors influencing sex differences in cognition

### *5.1 Introduction*

After having looked at the structural and functional dimorphism of the brain in men and women as well as the studies of lateralisation in healthy and injured brains, in the final part of my work I will reflect on some of the most important factors that may contribute to the former. I am going to talk about the role of hormones, biology, social factors, learning, and evolutionary theory in detail.

## *5.2 Hormones*

Some researchers have proposed that sex differences in cognition are influenced by various sex hormones early in life. Sexual differentiation of the brain causes permanent changes in brain structure. First, the differentiation of the sexual organs into male or female is settled, then the differentiation of the brain follows due to influence of sex hormones such as testosterone, estrogens and progesterone. During the prenatal period, the brain develops in a male direction in the presence of androgens (the primary androgen is testosterone), and the female brain is developed via a hormonal default mechanism, in the absence of androgen. Due to this hormonal influence on the developing nerve cells our gender identity, behaviour, sexual orientation and sex differences regarding cognition and aggressive behaviour are programmed into our brain structure when we are still in the womb (Swaab 2007). As Moir and Jessel describe it (1991: 21):

> It is not until six or seven weeks after conception that the unborn baby 'makes up its mind', and the brain begins to take on a male or a female pattern. What happens at that critical stage in the darkness of the womb, will determine the structure and organisation of the brain: and that, in turn, will decide the very nature of the mind.

Geschwind was one of the earliest researchers to emphasise that prenatal androgens affect the development of the right and left cerebral hemispheres. He has proposed that prenatal androgens aid faster right cerebral hemisphere development, allowing right hemisphere spatial skills to advance. He has also pointed out that extremely high androgen levels slow the development of both the left and right hemispheres (Baron-Cohen 2006).

Geschwind has studied babies whose mothers had undergone amniocentesis (a medical procedure administered to women who are thought to be at high risk of having a baby with genetic defects such as Down's Syndrome) during the first trimester of pregnancy. Those toddlers who had had lower fetal testosterone, now had higher levels of eye contact and a larger vocabulary. He also found that those children who had had higher pre-natal testosterone now had lower social skills, and were more aggressive. Lower levels of fetal testosterone lead to better levels of language, communication skills, eye contact, and social skills (ibid.).

Sex hormones not only act on prenatal life but also continue to have effects later on. This is clearly seen with respect to cognitive abilities. One of the most frequently studied areas is the relationship between sex hormones and cognitive abilities in females, especially verbal skills. Studies of this relationship have found that performance on particular cognitive tests varies with changing hormone levels, demonstrating that even mature adult brains are influenced by sex hormones.

During adult life, women's hormone levels fluctuate monthly with the menstrual cycle, and some studies have shown that these variations affect performance on certain test of cognitive abilities to some degree. Kimura tested women at different phases of the menstrual cycle to compare the effects of minimal and maximal estrogen levels. The results showed that the time of relatively high estrogen levels (called the prevulatory phase) was associated with small decreases in spatial ability and improved ability on tests of articulatory skills. In contrast, women scored much better on the mental-rotation test while their estrogen levels were at the lowest (Kimura 1999, 2002).

In her study of 138 adults Kimura also found that the spatial ability of males is subject to a seasonal fluctuation, their performance being better in the spring, when the testosterone level is low, rather than in fall, when it is higher. Men are also influenced by a daily cycle, because

their testosterone levels are the highest from 4 a.m. and the lowest around 8 p.m. (Gorman 1992).

These findings have been replicated by other scientists as well. Petersen, for instance, has reported that a more masculine body type in women correlated with higher spatial scores, but verbal fluency was unaffected. In males, a more masculine body type affiliated lower spatial than fluency scores, and a less masculine body type was associated with higher fluency than spatial scores. Some other studies have also reported that higher levels of testosterone were associated with lower spatial ability in male participants. Broverman, Klaiber, and colleagues have suggested that in men a more masculine appearance was linked to a proficiency at verbal tasks but lower proficiency on spatial tasks (Burton, Henninger & Hafetz 2005).

Taken together, these studies indicate that female sex hormones enhance performance of those skills that are usually completed better by females, whereas they cause a decrease in performance of those skills that are usually carried out better by males. However, prenatal hormones alone do not determine behavioural sex differences. Social and environmental factors undoubtedly contribute to differences between males and females. In the following subsection I am going to talk about these factors.

### *5.3 Nature or nurture?*

So far none of the scientists have figured out whether the effect of nature (most characteristics are attributed to biological differences) or nurture (social factors and learning which lead to the differences) plays a more significant role in the causes of sex differences.

As I have mentioned it in the previous subsection, according to the biological theory it is our hormones and brain wiring that are responsible for our attitudes, preferences, and behaviour. This means that if boys and girls grew up on a deserted island without a society or parents to teach them, girls would still hug each other and play with dolls, while boys would compete with each other and form groups with a clear hierarchy (Pease 2000).

However, another group of scientists claim that the behavioural and cognitive differences between the sexes are due to the influences of culture, parents and society. Social learning theory emphasises the importance of children's imitation of the behaviour of others. The theory posits that boys learn how to behave as boys from observing and imitating their fathers, and girls learn from imitating females, especially their mothers. Studies show that mothers spend more time with their baby girls than with their baby boy. Moreover, according to an experiment conducted by psychiatrist Dr. Micheal Lewis, they talk to, and look at baby girls more than baby boys. A major study at Harvard University shows that mothers not only behave differently toward boy and girl babies, they also use different words while talking to them. Mothers try to have an impact on their daughters' feelings and emphaticalness by saying sentences like "Oh, that was so kind of you to have made that for me." or "Can you imagine how she felt when you…?". On the other hand, boys are told to be strong and not to cry or be emotional (Baron-Cohen 2006). So maybe social conditioning, the fact that girls' mothers talked to them more, is the reason why girls talk more than boys.

However, gender differences are already apparent from just a few weeks after birth, when social influence is modest. Moir and Jessel (1993: 56) propose the following explanation for the early differences in children:

> These discernible, measurable differences in behaviour have been imprinted long before external influences have had a chance to get to work. They reflect a basic difference in the newborn brain which we already know about – the superior male efficiency in spatial ability, the greater female skills in speech.

Thus, it is possible that nature is more important than nurture, as a generation of parents discovered that no matter how hard they had been trying to give baseballs to their daughters and dolls to their sons, girls still were interested in dolls and dollhouses while boys climbed into tree forts (Gorman 1992).

A lot of carefully controlled studies where social learning and environment were eliminated have been carried out and scientists found that there exist numerous differences between the brains of men and women.

I propose that maybe it is neither nature nor nurture that is solely responsible for the sex-specific differences between men and women regarding behaviour and cognitive skills. My impression is that it is the interplay of both biology and cultural learning, so I share the view of the neuropsychiatrist, Louann Brizendine, who after a tremendous amount of research activities at her clinic claimed that "Gender education and biology collaborate to make us who we are" (Tannen 2006).

### *5.4 Evolution*

According to yet another theory most of the differences between males and females are caused by evolutionary reasons. Following the route indicated by Charles Darwin, it is suggested that behavioural traits that underlie these sex differences may have been selected because they improved the given person's chances of survival and reproduction.

Some theories propose that our male and female ancestors had very different roles and activities. If we accept this, than we may agree that the selective pressures were likely to have been different for each, so the environment might have selected different skills in males and females.

Cave men made tools and weapons, hunted and defended the group against predators. Cave women gathered and prepared food, made clothing and reared children. Such specialisation might have put different selection pressures on men and women. Hence, men most probably have been selected for long-distance navigation and for accurate targeting. Women in contrast, might have been selected for fine motor skills, short-distance navigation, and efficient perceptual discrimination, which enabled them to detect small changes, such as those in a child's face (Kimura 1999). Similarly, Silverman and Eals reasoned that men may have developed strong spatial skills in response to evolutionary pressures to be successful hunters, gatherer women needed other types of visual skills to be good at (Gorman 1992).

But how can evolution account for the hypothetical verbal superiority of women? The advantage of women in verbal skills may also be explained by the evolutionary theory. Men used to and still need physical strength to compete with other men and to protect their family, while women use language to gain social advantage by argumentation, gossiping or persuasion. A woman is not likely to beat up her enemy, rather she is going to gossip about her behind her back or to have a quarrel with her face to face.

Naturally, this evolutionary theory is only one possible way of explaining the differences between the two sexes and its validity is doubted by many people including me as well.

## 6 Conclusion

We all know that men and women are different. This does not mean that one of the sexes is better than the other, they are simply different. I wish to emphasise that these differences do

not mean a superiority-inferiority relationship between males and females. When I claimed that usually women excel at certain language skills and men at spatial skills this was a simplification. Of course, we can always find exceptions to this generalisation, since there are some excellent female pilots and male interpreters as well.

As for the explanation of sex-specific differences in cognition and behaviour there have been numerous theories. In the past nature was held to be the primary reason of these differences. Then in the 1960s, Locke's "tabula rasa" thesis, which proposes that the human mind is "blank" at birth and its content is built up step by step from the experiences of the world, was rediscovered and aspects of behaviour were attributed to nurture. In the 1990s, the evolutionary theory emerged by assigning almost every gender difference to the evolution of the brain and natural selection. At the end of the 20th century more and more works were published on the significance of hormones and the differences in brain structure. In this article I have attempted to give a more or less detailed account of these as well, pointing out the inconsistencies and lack of consensus.

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