

## **Sex and Cognition**

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### **ABSTRACT**

*The fight for supremacy between man and women is an ongoing gender conflict process. Man always tries to hold power position; be it in the Ramayan era or Mahabharat, we find several instances of this tussle. We all know that gender is a social phenomenon whilst sex is a biological event. This paper makes an attempt to review the studies conducted by different researchers in the field of Neuroscience and physiological Psychology to reveal the sex differences in verbal, spatial, visuo-spatial, and perception, as well as anatomical and structural cerebral asymmetry.*

**Keywords :** *Asymmetry , Perception, Sex, Visuo-spatial ability.*

### **I. INTRODUCTION**

Many social scientists claim that it is unnecessary to invoke biological factors at all in explaining gender differences in their cognitive abilities. They prefer to attribute the variations to environmental, including socialization influences. The bias against biological explanation seems to have arisen from egalitarian ideologies that professes that all people are in fact equal. Egalitarians believe that most of our differences are due to environmental/nurturance factors (Kimura Doreen,1999)<sup>1</sup>.

#### **I.1 RATIONALE**

Men and women are alike in a number of ways. This paper reviewed the studies conducted in different areas. There are evidences of sexual differences in cerebral asymmetry and cognitive abilities. Discovering the mechanism of sex differences not only helps us understand differences between men and women, but between individuals of the same sex as well. Through findings we can investigate whether persons with one kind of brain pattern, either men or women, also have cognitive or other characteristics that could be predicted by this feature.

#### **I.2 STEREOTYPES REGARDING GENDER DIFFERENCES**

We all know that men and women are physiologically different, but are clear gender differences in intelligence, personality, cognition, or behavior are issues more difficult to address. There are many stereotypes concerning gender differences; few of these are listed below:

1. Females are more caring and nurturing, and therefore make better mothers, teachers, nurses, etc.
2. Males are less friendly and more aggressive. They are more suited to leadership and for roles in business, military and politics.
3. Women have better verbal abilities, and are interested in social relationships and emotional issues.
4. Males are more interested in objects than people and do not easily show their emotions.
5. Females are poor at spatial skills, particularly if machines are involved (like parking a car), cannot find their way around, and are hopeless at throwing.
6. Males are better at science and maths, while females are better at art and social science subjects.

## II SEXUAL DIFFERENCES IN CEREBRAL ASYMMETRY.

Cerebral asymmetry is a significant feature of cerebral organization (Kolb & Whishaw (1990)<sup>2</sup>. One of the important features of cerebral asymmetry is the substantial individual variations in the pattern of left-right differences in both anatomical and functional asymmetry.

### II.1 ANATOMICAL ASYMMETRY

No two brains are alike. Brains differ in their size, gyral pattern, grey and white matter ratio, etc. Studies primarily found three statistically reliable anatomical differences related to gender in human.

1. There are more females than males exhibiting a reversed asymmetry pattern in *Planum temporale*, although the predominant pattern is still like that observed in males. (Wada 1975)<sup>3</sup>
2. Through neuro-encephalograms of neurological patients the presence of *massa intermedia* (a bond of tissues joining the thalami) was studied. It was found that in about 2/3<sup>rd</sup> males and 1/4<sup>th</sup> females this tissue was absent. Studies found that males with the *massa intermedia* had lower nonverbal scores on Wechsler Bellevue Intelligence Test than those without this structure, but there was no comparable result in females. One interpretation of this result is that *massa intermedia* in males produces competition and interference between the lateralized functions of the two hemispheres. (Lansdell and Davie, 1972)<sup>4</sup>
3. The posterior part of Corpus Callosum (the *splenium*) is significantly larger in females than in males. It is also found that female *splenium* is bulbous and widens markedly with respect to the body of the Callosum. Male *Splenium* is approximately cylindrical and relatively continuous with the body of Corpus Callosum. (de Lacoste –Utamsing and Holloway, 1982)<sup>5</sup>. It is also found that Corps Callosum is not proportional to brain size in males and females.

## **II.2 FUNCTIONAL ASYMMETRY**

Sex is one of the obvious sources of individual variation in the behaviour of humans. There are numerous evidences of cognitive differences between males and females. Evidences regarding sex difference in cerebral organization derive primarily from normal subjects, laterality studies, cerebral blood flow measurement, and neurological patients. Studies were conducted in different areas/abilities.

### **II.2.1 PERCEPTION AND ATTENTION.**

All of our information about the world comes from our sensory systems and the cognitive process begins with the ability to sense changes in the environment, and to make some meaning out of sensory stimuli. The first steps in the cognitive process are perception and attention. Baker (1987)<sup>6</sup> summarised sex-related differences in perception and attention, and according to him females are better at detecting pure tones. Males are better at detecting peripheral visual movements whilst females have better acuity. They have lower thresholds for detecting sweet, sour, salty, and bitter substances. They are more sensitive to touch on most regions of the body. Sex ratios for Attention Deficit Hyperactivity Disorder (ADHD) show a much greater proportion of male sufferers (ranging from 3:1 to 9:1).

### **II.2.2. GENERAL INTELLIGENCE**

While male brains on an average are larger than female brains, size is no guarantee of intelligence and the common finding on standard tests of general intelligence (IQ) is that males and females show no differences. However, sex differences do emerge in terms of general knowledge. Using 20 domains of knowledge, Rolfhus & Ackerman (1999)<sup>7</sup> found that males outperformed females in history, politics, geography, and science, while females only outperformed males in art. Lynn & Irwing (2002)<sup>8</sup> assessed 19 knowledge domains in 1047 undergraduates. Males performed better in the fields of sport, science, current affairs, geography, politics, and history; females outperformed males on medicine and cookery.

### **II.2.3 VERBAL ABILITIES**

In their review, Maccoby & Jacklin (1974)<sup>9</sup> concluded that during the pre-school and early school years, girls outperform boys in most aspects of verbal performance. They say their first word earlier and articulate more clearly at an earlier age. Girls use longer sentences, are more fluent, and learn to read sooner. They also perform better on tests of grammar, spelling and word fluency.

Differences in verbal ability are the first to appear developmentally. There are evidences that girls begin to talk earlier than boys, and when they do they produce longer utterances with more advanced linguistic forms, and make fewer errors. (McGuiness, 1976)<sup>10</sup>. Martin & Hoover (1987)<sup>11</sup> conducted a large-scale longitudinal study on over 9000 children for 6 years and found that girls consistently scored higher on spelling, punctuation, language use, reading and comprehension.

A strong female advantage in verbal abilities was taken for granted for many years. However, in a comprehensive meta-analysis of 165 studies that had assessed sex differences in verbal ability, Hyde & Linn (1988)<sup>12</sup> found that all of the differences were very small, and an analysis by age showed no differences in the magnitude of gender differences.

Females only seemed to outperform males in verbal fluency and synonym generation; while males outperformed females on verbal analogies. They concluded that there was little evidence for a clear sex difference in verbal ability. However, some of the clearest evidence comes when we consider the lowest end of the verbal abilities distribution. Stuttering is overwhelmingly a male problem with a ratio of something like 4:1 in an adverse tilt towards males. Similarly, reading disabilities (dyslexia's) is also a predominantly male problem with the severest forms of dyslexia occurring 10 times more often in males. Even boys who are not classed as language impaired are much more likely to show speech production problems and are usually slower at learning to read. Finally, after brain damage- when language has been affected- males suffer more language impairment and take much longer to recover language skills compared to females who have suffered similar damage (Halpern, 1992)<sup>13</sup>.

#### II.2.4 VISUO-SPATIAL ABILITIES.

Like verbal abilities, spatial ability is not a single cognitive entity but comprises several different skills. Linn & Peterson (1985)<sup>14</sup> have defined it as "a skill in representing, transforming, generating, and recalling symbolic, non-linguistic information".

II.2.4.1 SPATIAL PERCEPTION: This requires the ability to locate the horizontal or the vertical whilst ignoring distracting information. 'Rod and Frame task', which requires the ability to ignore the surrounding frame ('field independence'), throws results wherein males, on an average, show a moderate-large advantage.

In the Water Level Task the participant is shown an empty jar and asked to draw in the water line if the jar is half-filled. Knowledge that the water line remains horizontal is shown by about 85% of college men but only by 50-65% of college women, and this finding has been replicated many times across cultures and age-range (Wittig & Allen, 1984)<sup>15</sup>. Kalichman (1989)<sup>16</sup> invented a more ecologically valid test in which a tilted glass is depicted being held by someone and they still found a robust sex difference favouring males.

In the Judgement of Line Angle and Position test the participants have to match each of the target line segments in the top half with a numbered line from the bottom half (based on position and angle). This shows a large male advantage (Collaer & Nelson, 2002)<sup>17</sup>.

**II.2.4.2 MENTAL ROTATION** This test includes the ability to imagine how geometrical objects will appear when they are rotated; performance on such tests typically reveals a large male advantage (Voyer et al., 1995)<sup>18</sup>.

**II.2.4.3 SPATIAL VISUALIZATION** This refers to the complex analytical processing of spatial information and includes such tests as Embedded Figures, hidden figures and spatial relations. In such tests participants are shown a simple geometric form and then pick it out from a more complex form, or asked which of a range of 2-D stimuli are the same as a 3-D example. Males only show a small, often non-significant, advantage in such tasks.

**II.2.4.4 SPATIO-TEMPORAL ABILITY** This involves judgements about and responses to dynamic (moving) visual displays. Tasks include time of arrival judgements and 'real-life' tasks such as throwing and catching, and intercepting objects. In such tasks males typically outperform females (Watson & Kimura, 1991)<sup>19</sup>.

**II.2.4.5 RECALL OF OBJECT LOCATIONS** This involves the presentation of a large array of objects (drawings or actual items) for a limited amount of time. The objects are then removed and the person asked to recall the objects they have seen. This type of task often shows a moderate female advantage (Silverman & Eals, 1992)<sup>20</sup>.

**II.2.4.6 NAVIGATION** Spatial tests (bar one) show a male advantage, this advantage appears to carry over into more real-world spatial tasks such as finding one's way around. Galea & Kimura (1993)<sup>21</sup> showed males and females a map of a town and asked them to learn a route through the town. Males made fewer errors and took fewer trials to reach criterion; interestingly females recalled more of the landmarks from the map (perhaps related to the superior ability in object recall).

## **II.2.5 QUANTATIVE ABILITIES**

Like spatial ability, quantitative ability consists of several different skills. Hyde et al., (1990)<sup>22</sup> conducted a meta-analysis of 100 studies which had focussed on sex differences in quantitative ability. Overall they reported that females showed a slight advantage in mental arithmetic and in the understanding of mathematical concepts. Males showed a small advantage in complex problem solving. Clear sex differences only emerged during later school years and college, where males begin to excel, perhaps because the focus on mathematics shifts from arithmetical calculations to more visuospatial domains (geometry, calculus). The largest difference occurs in the mathematics section of the SAT's test- a test primarily concerned with problem-solving. This shows a large male advantage with disproportionately more males scoring in the higher ranges and correspondingly more females scoring in the lowest range. Benbow et al., (1983)<sup>23</sup> tested around 65,000 pupils aged 11-13 on the SAT-M and found that males were represented at the highest level at a ratio of around 13:1.

#### II.2.6 AGGRESSION

Males are physically more aggressive than females. A sex difference is present as early as social play begins, at age 2 to 3 years, and remains through the college years. Studies with non human primates, largely rhesus monkeys, is probably a result of the male hormone androgen both pre and post natally.

### III CONCLUSION

Although most of findings are preliminary and inconclusive, they do hold promise for helping to better understand the brain and the biology of our behaviors. The research into gender differences needs to be approached with caution. By seeking, reporting, and discussing sex differences, psychologists lend scientific prestige to the distinction between men and women. It unnecessarily endorses a way of looking at the world in which men and women are fundamentally different. Without some theory in advance about sexual differences, we might find ourselves in a kind of a big fishing expedition, but that also helps keep the search endlessly fascinating.

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