Susana Carmona: "My primary interest is to ask questions, try to answer them and communicate what I learn”

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Susana Carmona directs the Neuromaternal research group at the Gregorio Marañón Hospital in Madrid

In 2017 Susana Carmona's team demonstrated for the first time that the anatomy of the brain in postpartum mothers 3 months after birth was different than what it was before they got pregnant for the first time. Her team explained what mothers already sensed: motherhood transforms us. Carmona, Psychologist and Neuroscience Doctor, directs the Neuromaternal research group at the Gregorio Marañon Hospital in Madrid, this group researches the brain changes that come with pregnancy and motherhood. In her book Neuromaternal, she gathers scientific information about this process and asks and answers many important questions about pregnancy, a condition that nearly 85% of women experience at some point in their life.

- **What happens in a woman's brain during pregnancy?**

Our studies strongly prove how a woman's brain changes dynamically and persistently during pregnancy, modulated by hormones. These changes are directly connected to the endocrine, immune and cardiovascular systems. They are crucial and require more attention.

- **What do pregnancy, menopause and adolescence have in common?**

They are all periods where abrupt hormone changes take place, which make the body and the brain readapt themselves, thus increasing vulnerability. That's why pregnancy, adolescence and menopause are periods with a high incidence in diseases in women, those such as anxiety and depression.

- **Why do changes occur in pregnant women's brains?**

We are trying to identify the different mediating factors. In animal models, the hormones, especially estrogens, play a crucial role, along with others like prolactin, progestins and oxytocin. Estrogens are important in humans, but they are not the only ones. These interact with the cells from the immune system and the blood flow which increases up to about 50%. Identifying just one causing factor is impossible due to the complexity of the process.

- **In your book «Neuromaternal» you affirm that new neurons are generated in the brain.**

In mice models, yes. In the subventricular part of the brain, cells that are influenced by prolactin, are generated and these migrate toward the olfactory bulb before the birth, helping the mother recognize the smell of her child. Verifying this in humans is very difficult.

- **Does personality change during pregnancy?**

The idea that personality changes during pregnancy is related to the concept of matrescence. The book relates experiences from many mothers and theoretical psychological data. Neuroimaging techniques show changes in parts of the brain involved in the perception of the self, but it is a very complex issue.

- **How are the changes in the brain during pregnancy?**

In humans, we have not been able to test it completely. In animal models, during the first pregnancy strong changes are produced, and then there are readjustments in successive pregnancies. Cross-

sectional studies in middle aged women suggest that pregnancy has cumulative effects on the brain. Machine learning models estimate that women who have had children have younger brains, with a limit of up to 3 years.

- **Most of the people who lead these types of researches are women. Certainly, you have been asked about female empowerment in science.**

It's not just about empowerment or social justice. We have contributed perspectives that perhaps men don't consider relevant. Processes like menopause, the menstrual cycle or birth control are usually ignored in traditional medical research.

- **That's because the medical research conducted by men didn't see it as a priority.**

I don't know if it's malice or ignorance, probably a mix of both. They have not gone through these processes, thus don't understand their impact on mental and physical health in women. It seems like it's more lack of interest than malice, a bit like "This doesn't affect me, I have bigger problems to deal with". However, problems such as breast cancer have evolved a lot because time was invested in them. If we have sent a man to the moon, we have resources to research this. Yes, it's a question of priorities. And also, of representation. There's a saying that I like a lot, which is: "I don't worry as much about geniuses like Einstein as I do about those brains that got lost on the way." The absence of women in key positions limits what is considered important to research.

- **It is contradictory. In centers that praise themselves about being inclusive, the majority of the senior directors are men, despite there being more women on staff than men.**

That happens in a lot of places. The data from the Carlos III Health Institute shows a clear "scissor effect": more women at the bottom and a lot less in the high positions. The increase in the number of women in science and in positions of power to decide what is relevant to study, has influenced in the research of processes related to women. Bias in clinical studies has been resolved, and processes like pregnancy or menopause, which in the past were forgotten, are now starting to be studied more thoroughly. These processes involve big hormonal fluctuations. The hormones, that have receptors in the brain cells, induce neuroplasticity. Therefore, during pregnancy and menopause, the brain cells have to readapt themselves and work in a different way. It was almost obvious. The weird thing was that nobody had studied it before.

- **How did you become interested in science?**

I have always been very curious. I remember being in the kitchen with my mother, asking strange questions or playing with food as if it were part of an experiment. Even with the cat, I thought, "If I put something here, will it change color?" Things like that, but it wasn't that I wanted to pursue science.

- **You also draw.**

Yes, drawing is my passion. Actually, at first, I thought about studying Psychology so I could then pursue Fine Arts as a hobby. But then I received scholarships, and opportunities, like a stay in the United States, and I ended up immersing myself in all of this. Though, deep down, I'm still passionate about Humanities.

- **Your explanations are very visual, and your book (Neuromaternal) also reflects this, with images that allow one to better understand what is happening.**

Yes, I think it has to do with my inclination towards art. Although I like science very much, I don't consider myself to be a "pure" scientist. My main interest is to ask questions, try to answer them and communicate what I learn.

- **Do you think there is a dichotomy between Science and Humanities?**

That's right, they make us choose, and it's too bad. I think there is a wonderful bridge between both areas. Science is essential, but there are other types of knowledge equally valuable. My book tries to connect these perspectives: science, psychology, art, human experiences. It's a way of looking at a phenomenon, from different angles, and I love that.

- **It's obvious that you are interested in communicating.**

Exactly. I started communicating to recruit participants for my studies. I created an Instagram account, initially for that purpose, and little by little, I realized how important it was to explain what we do and give something back to those who participate.

- **Have you had any "crazy" research idea that you haven't been able to do yet?**

I think I've already done it. We evaluated women before and after pregnancy, something that was quite innovative at the time. It was risky because some women don't end up getting pregnant, and it took us almost 10 years to publish. Though it's quite known now, at that time, nobody spoke about the maternal brain.

- **Do the great ideas usually arise outside the laboratory?**

Totally. I believe that the best ideas come up when we are relaxed, like when you are reading something from another field. For example, mixing medical anthropology with neuroscience made me ask myself if brain changes during pregnancy could be compared to those of adolescence.

- **And speaking of great ideas, if you had an unlimited budget, time and resources, what project would you work on?**

I would love to create a database about women, to study how pregnancy affects risk and resilience on a long-term basis. We could provide answers to questions like if the risk of Alzheimer and cardiovascular diseases varies depending on the number of pregnancies. It would be a multidisciplinary job, combining biology, communication, and even public policies. To make it accessible, I'd invite the public to participate using an app where they'd record information about their health and receive personalized updates according to the findings. This project could change our understanding of feminine health and its impact on global health policies.