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INNOVATORS & IDEAS: RESEARCH LEADER

Annamaria Cattaneo: Three main questions: Stress, mental, and physical health: Is the gut microbiome the key? Which are the biological mechanisms driving perinatal depression, and how do they affect the mental and physical health of the offspring? Pharmacological and non-pharmacological interventions in reducing the risk of developing mood disorders or in improving symptomatology: Is inflammation the key driver?

Brain Medicine March 2025;1(2):22–25; doi: https://doi.org/10.61373/bm024k.0079

Keywords: Stress, inflammation, gut microbiome, interventions, biomarkers, mood disorders

Annamaria Cattaneo is an Associate Professor at the University of Milan, Department of Pharmacological and Biomolecular Sciences, and the Head of the Laboratory of Biological Psychiatry at the IRCCS Fatebenefratelli Institute in Brescia, where she is also Deputy Scientific Director. She is currently associate editor of *Brain, Behavior, & Immunity—Health*, an official journal of the Psychoneuroimmunology Research Society. She dedicates her research to understanding the complex interplay between early life adversities and the development of mental health disorders. Her work focuses on the biological mechanisms, such as neuroplasticity, inflammation, gut microbiome, and epigenetics, that connect early life experiences to mental health vulnerabilities later in life. Recently, Dr Cattaneo has expanded her research to explore the liver-brain axis and its role in the development of comorbidities between mental and physical disorders. Additionally, she is actively involved in identifying peripheral biomarkers associated with the risk of developing mood disorders and treatment response. A significant focus of her current work is on perinatal depression, aiming to uncover the biological, social, and environmental factors that shape the risk for depression during pregnancy and its impact on offspring outcomes. As the Coordinator of the HappyMums Project, a Horizon Europe initiative, she leads efforts to improve our understanding of the biological mechanisms underlying the development of depressive symptoms in pregnancy and the efficacy of interventions. Dr Cattaneo's passion for her work extends beyond the laboratory, as she actively engages in dissemination activities to raise awareness about mental health issues among the general population. Through events like the *HappyRun* in the Monza Park and *Luci e Ombre* / *Lights and Shadows*, she brings together science, art, and community to promote mental well-being. In this "Genomic Press Interview," Annamaria Cattaneo kindly shares insights into her life and impressive career, providing our readers with a glimpse into the driving force behind her ground-breaking research and tireless efforts to advance our understanding of mental health.

Figure 1. Annamaria Cattaneo, PhD, University of Milan and IRCCS Centro San Giovanni di Dio – Fatebenefratelli, Italy.

Part 1: Annamaria Cattaneo – Life and Career

Could you give us a glimpse into your personal history, emphasizing the pivotal moments that first kindled your passion for science?

From a young age, I have been deeply drawn to scientific inquiry. This passion has shaped my academic journey, guiding me toward disciplines like molecular biology and pharmacology.

Growing up, I was always curious about how things worked. However, it was only in high school that I truly realized the depth of my interest. I had a biology teacher who brought the subject to life, explaining complex concepts in a way that made them fascinating and accessible. I started to develop an interest in the field of medicine. However, in the way, I wanted to know more about the causes of underlying pathologies and ways to treat them successfully. In that period, I also lost a family member because of an illness (cancer), and this event strengthened my determination to explore and discover the origins of certain medical conditions and to seek ways to prevent or treat them. I understood the power of science to not only answer questions but also to ask new ones. This realization drove me to pursue a career in research, where I can explore the unknown and

Received: 28 August 2024. Accepted: 20 September 2024.
Published online: 3 October 2024.

contribute to expanding our understanding of the world. These experiences, combined with a deep-seated curiosity and a drive to make a meaningful impact, have fuelled my passion for science ever since. They set me on a path that has been both challenging and incredibly fulfilling, and they continue to inspire me in my work today.

We would like to know more about your career trajectory leading up to your most relevant leadership role. What defining moments channelled you toward that leadership responsibility?

Although I initially focused on cancer research during my studies at the University, my career path shifted after a one-year research traineeship in a laboratory specializing in preclinical mental disorders studies. This experience sparked a new direction in my research interests. Also, immediately after my degree in pharmacy, I had the opportunity to pursue a PhD in molecular genetics and apply it to medical sciences at a psychiatric institute, enabling me to continue focusing on mental disorders. Conducting my PhD research at a psychiatric hospital profoundly impacted my career trajectory, as it deepened my understanding of the critical role that science and research play in advancing the mental health field. This experience not only intensified my passion for the field but also allowed me to develop critical aspects of my research independently. During my PhD, I honed essential skills such as grant writing and student supervision, which have been instrumental in my career. Another important moment was in 2013, when I secured my first grant—an ERANET Neuron grant—which not only funded my own salary but also supported the first two researchers who joined my team. This marked the birth and growth of my lab, which now includes 21 researchers, ranging from undergraduate students to PhD candidates and postdoctoral fellows, and more than 15 grant-funded projects.

Please share with us what initially piqued your interest in your favourite research or professional focus area.

During my career, I have always been interested in the link between adverse experiences in early life—such as childhood and adolescence—and the onset of mental illnesses in adulthood. The birth of my three children has significantly enriched my life and sharpened my scientific focus on the profound biological changes in women during sensitive periods such as pregnancy and post-partum. Different lines of research highlight the crucial impact of the perinatal period on long-term developmental outcomes in children. This has deepened my scientific interest in understanding how stress and other adverse exposures during the perinatal period might influence the immediate health of mothers and their children and the potential transgenerational effects. Furthermore, given the significant role of the environment in shaping both individual vulnerability and resilience, I am particularly interested in investigating postnatal factors that may serve as moderators and protectors against risks established in utero that can arise from maternal mental illness or high-stress exposure during pregnancy. These postnatal protective factors could be essential in potentiating resilience, and indeed, my research focuses on how these postnatal influences can potentially mitigate or buffer the adverse effects of prenatal stressors, ultimately promoting healthier developmental outcomes.

My research now seeks to elucidate the complex biological mechanisms that mediate these impacts, including hormonal, inflammatory, and epigenetic changes, to inform more effective interventions and preventive strategies.

What impact do you hope to achieve in your field by focusing on specific research topics?

The several projects I'm focusing on all share a common goal: to improve the well-being of individuals with mental disorders or those who are at high risk of developing these pathologies. Much of my research focuses on identifying biomarkers in blood or saliva, which can be pivotal in enhancing clinical practices for prevention, diagnosis, and treatment. Recently, I've expanded my work to incorporate AI tools, aiming for more direct and non-invasive impacts on public health. For instance, the projects focused on perinatal psychiatry include an app designed to remotely gather different data from mothers, monitor and enhance lifestyle choices to promote mental well-being during pregnancy, and continuously assess the effectiveness of treatments.

Please tell us more about your current scholarly focal points within your chosen field of science?

My main scientific interest lies in exploring the roles of inflammation, stress, and, more recently, the gut microbiome. A better understanding of the alterations in these biological processes that can be observed in patients suffering from both mental and physical illnesses is pivotal for the development of personalized interventions. For instance, it's common to find that patients with depression have undergone stressful events, exhibit heightened central and peripheral inflammation, and experience intestinal dysbiosis. Additionally, some of these patients do not respond to conventional drug treatments. This evidence drives my curiosity to understand how these fundamental mechanisms are interconnected and how they influence responses to pharmacological interventions. My goal, as I have mentioned, is patient care: by delving deeper into these mechanisms, I hope to contribute to optimizing therapeutic approaches, potentially reducing the need for patients to endure multiple, often unsuccessful, treatment trials.

What habits and values did you develop during your academic studies or subsequent postdoctoral experiences that you uphold within your research environment?

During my studies and postdoctoral experiences, I learned the importance of maintaining rigorous scientific methods, ensuring that all experiments are meticulously designed and executed precisely and accurately. Now, as a lab leader, I prioritize upholding these standards, not only for myself but also for the researchers I mentor. This discipline is fundamental to publishing reliable papers and ensuring that our results can be reproducible by others, above ourselves, which is crucial for advancing scientific knowledge.

I am also dedicated to conducting all work with transparency and honesty, ensuring that every result is reported accurately. Upholding these ethical standards is essential for maintaining the credibility of our research.

Additionally, I have also learned the importance of curiosity, collaboration, and perseverance, values that I try to disseminate to people in my lab. By regularly engaging with high-quality research publications, we can feed our intellectual curiosity and expand our knowledge, allowing us to develop new ideas and approaches. Research cannot be done by a single researcher/individual: interacting with others is essential to refining our work and making our projects more competitive. The exchange of ideas often leads to breakthroughs that would only be possible. Perseverance is equally crucial. Consistent, hard work—approached with determination rather than superficiality—is the key to producing high-quality research that leads to impactful publications. I also learned the importance of mentorship. Therefore, I actively work to support the growth of younger researchers like my mentors supported me. I prioritize fostering a learning environment where everyone feels empowered to succeed.

At Genomic Press, we prioritize fostering research endeavours based solely on their inherent merit, uninfluenced by geography or the researchers' personal or demographic traits. Are there particular cultural facets within the scientific community that warrant transformative scrutiny, or is there a cause within science that deeply stirs your passions?

I feel perfectly aligned with the priorities adopted by Genomic Press.

What do you most enjoy in your capacity as a research leader?

I am incredibly fortunate to be a scientist. What I most enjoy as an academic and researcher is the opportunity to explore uncharted scientific territories and contribute knowledge that can have a tangible impact on patients' lives. I take great satisfaction in developing projects and

designing interventions to improve patients' well-being and quality of life, above their symptoms, and in inspiring the next generation of researchers.

Outside professional confines, how do you prefer to allocate your leisure moments, or conversely, in what manner would you envision spending these moments given a choice?
I love spending time with my family and traveling. Our home setting encourages outdoor activities in nature, such as walking or having picnics in the nearby mountains. I plan trips to enjoy quality time together, ideally by the seaside whenever possible. I also organize special outings with just one of my children, allowing me to focus on each of them individually. For example, when I travel for conferences abroad, I sometimes bring my daughter to have some one-on-one time together. Last year, I also took my second child, who was eight years old, with me to Turin because I had a talk there. During my free time, we visited the Juventus stadium, hoping I could persuade him to switch allegiance to my favourite team. Unfortunately, my efforts failed—he remains a steadfast Inter fan. We even stopped by the Juventus shop to buy a jersey, but when the staff asked which name to put on it, he boldly requested the name of an Inter player. I truly wanted to disappear right there—on the spot.

Part 2: Annamaria Cattaneo – Selected questions from the Proust Questionnaire[1]

What is your idea of perfect happiness?
My idea of happiness is connected to small, simple moments—those brief, individual experiences or events during the day, such as a text message, a hug, a smile, coming back home after a tough working day, or even an email saying that a submitted paper has been accepted for publication or a symposium accepted for a conference. To me, happiness also means peacefulness and the absence of worries.

What is your greatest fear?
As trivial as it may sound, my greatest fear is death. Death feels insurmountable, unlike other challenges we may face, which can often be overcome, tolerated, or resolved.

Which living person do you most admire?
It's a person very close to me who, despite he had to face difficult experiences, he always finds a way to smile and to stay positive. When negative things happen to me, he always encourages me and oblige me to focus on positive aspects I have.

What is your greatest extravagance?
Balancing a career as a scientist with raising three young children.

What are you most proud of?
The passion and enthusiasm I put into everything I do: I am a mom of three young kids and a scientist managing a lab with more than 20 researchers.

Figure 2. Dr. Annamaria Cattaneo enjoying a sunny day by the sea, her preferred living environment. The image captures Dr. Cattaneo smiling warmly while wearing a woven sun hat, embodying the calming and inspirational atmosphere she describes as her ideal setting. The clear blue sky and glimpse of colourful foliage in the background hint at the seaside location she finds so appealing for its soothing waves, refreshing breezes, and invigorating sunlight.

What is your greatest regret?
I have yet to be able to renovate my parents' house, which is where I would love to move with my family.

What is the quality you most admire in people?
Respect, honesty, and transparency.

What is the trait you most dislike in people?
Selfishness.

What do you consider the most overrated virtue?
Modesty.

What is your favourite occupation (or activity)?
Scientific dissemination is certainly one of my favourite activities in the working environment, whether it is done in the most classic way or through more original, pleasurable, and entertainment activities. The idea is, therefore, to reach not only the scientific community but also young people and people in general.

Where would you most like to live?
A city by the sea is my preference. The sound of the waves, the sea breeze, and the sunlight create a calming atmosphere and serve as a source of inspiration (Figure 2).

What is your most treasured possession?
It's a travel souvenir, specifically a bag woven from palm leaves I brought back from my trip to Tanzania.

When and where were you happiest? And why were so happy then?
The birth of my children is one of the most joyful moments of my life, because this filled me with love and gratitude. It has forever changed the way I view the world and people around me.

[1]In the late nineteenth century, various questionnaires were a popular diversion designed to discover new things about old friends. What is now known as the 35-question Proust Questionnaire became famous after Marcel Proust's answers to these questions were found and published posthumously. Proust answered the questions twice, at ages 14 and 20. In 2003 Proust's handwritten answers were auctioned off for $130,000. Multiple other historical and contemporary figures have answered the Proust Questionnaire, including among others Karl Marx, Oscar Wilde, Arthur Conan Doyle, Fernando Pessoa, Stéphane Mallarmé, Paul Cézanne, Vladimir Nabokov, Kazuo Ishiguro, Catherine Deneuve, Sophia Loren, Gina Lollobrigida, Gloria Steinem, Pelé, Valentino, Yoko Ono, Elton John, Martin Scorsese, Pedro Almodóvar, Richard Branson, Jimmy Carter, David Chang, Spike Lee, Hugh Jackman, and Zendaya. The Proust Questionnaire is often used to interview celebrities: the idea is that by answering these questions, an individual will reveal his or her true nature. We have condensed the Proust Questionnaire by reducing the number of questions and slightly rewording some. These curated questions provide insights into the individual's inner world, ranging from notions of happiness and fear to aspirations and inspirations.

What is your current state of mind?
Mostly positive.

What is your most marked characteristic?
My most distinctive trait is perseverance and the ability to bounce back.

Among your talents, which one(s) give(s) you a competitive edge?
A talent that sets me apart is my emotional intelligence. My ability to understand and regulate both my own emotions and those of others enables me to navigate complex interpersonal dynamics, foster strong relationships, and lead teams effectively, even in difficult circumstances.

What do you consider your greatest achievement?
A significant achievement in my career has been my progress over the years. In 2013, I secured my first grant—an ERANET Neuron grant—which funded my salary and supported the first two researchers who joined my team. Today, my lab has grown to include 21 researchers, including PhD students. This growth is a testament to years of perseverance, dedication, and hard work, as well as the support my family received. I could never be a scientist in my career and, at the same time, raise three kids without the support from my family.

If you could change one thing about yourself, what would it be?
If I could change one thing about myself, it would be to strike a better balance between directness and diplomacy. While I value honesty and transparency, I recognize that sometimes a more nuanced approach is needed to communicate effectively and maintain harmonious relationships.

What do you most value in your friends?
In my friends, I appreciate trust, honesty, and empathy.

Who are your favourite writers?
Honestly, I have not had much time to read books lately. A few years ago, when I had more free time, I read several books by Bambaren and King Albon.

Who are your heroes of fiction?
My favourite hero is Catwoman, a complex and intriguing character known for agility, cunning, strength, and independence. As a master thief with a robust moral code, she often straddles the line between hero and anti-hero. Her feline elegance and originality make her a formidable presence, while her depth and duality reveal a layered personality that challenges conventional notions of good and evil.

Who are your heroes in real life?
Jane Goodall: A renowned primatologist and conservationist, Jane Goodall's pioneering studies on chimpanzees revolutionized our understanding of animal behaviour. Her lifelong dedication to wildlife conservation and humanitarian work has made her a leading environmental and animal rights advocate.

What aphorism or motto best encapsulates your life philosophy?
Here I would like to cite a song from one of my favourite Italian singers, Vasco Rossi which says: *"I want a reckless life; I want a life like in the movies; I want a life where it's never too late; One of those where you never sleep; I want a life; You'll see what a life it will be, uh."*

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