# International study uses artificial intelligence to show how personality influences the expression of our genes

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Research news

An international study led by the UGR using artificial intelligence has shown that our personalities alter the expression of our genes. The findings shed new light on the long-standing mystery of how the mind and body interact.

The study, published in the journal Molecular Psychiatry (Nature), examines how an individual's personality and underlying outlook on life regulate their gene expression, and thus affect their health and well-being. It is the first study to measure the transcription of the entire genome in relation to human personality.

The multi- and interdisciplinary study was led by researchers from the Andalusian Interuniversity Research Institute in Data Science and Computational Intelligence (DaSCI), the UGR's Department of Computer Science and Artificial Intelligence, and the Biohealth Research Institute in Granada (ibs.GRANADA). It was carried out in collaboration with Professor Robert Cloninger (Washington University in St. Louis), researchers from Baylor College of Medicine (Texas, USA) and the Young Finns Study (Finland).

The international research team (made up of specialists in genetics, medicine, psychology and computer science) used data from the Young Finns Study, an extensive study conducted in the general population of Finland over four decades during which relevant information was collected on participants' health, physical condition and lifestyle. In addition, participants were subjected to extensive personality assessments that addressed both temperament (habits and emotional reactivity) and character (conscious goals and values). The results showed that certain outlooks on life are conducive to a healthy, fulfilling and long life, while others lead to a stressful, unhealthy and short life.

The study analysed the regulation of gene expression in these individuals, taking into account three levels of self-awareness that were measured through their combined temperament and character profiles. These levels were designated “unregulated” — individuals dominated by irrational emotions and habits associated with their traditions and obedience to authority, “organised” — self-sufficient individuals capable of intentionally regulating their habits and cooperating with others for mutual benefit, and lastly, “creative” — self-transcendent individuals who adapt their habits to live in harmony with others, with nature or with the universe, even if this requires occasional personal sacrifices.

**Two key findings**

As UGR researcher and co-lead author of the study Coral del Val explains: “In our research we made two key discoveries about the expression and organisation of genes according to the personality profiles of these individuals. First, we discovered a network of 4,000 genes that clustered into multiple modules that were expressed in specific regions of the brain. Some of these genes had already been linked in previous studies to the inheritance of human personality. Second, we discovered that the modules formed a functional interaction network capable of orchestrating changes in gene expression in order to adapt to varying internal and external conditions. The modules turned on and off in a flexible manner, facilitating adaptation to the everyday challenges we all face, and choreographing our development”.

The researchers showed that the changes in the patterns of interaction between these modules were orchestrated by two sub-networks. One network regulated emotional reactivity (anxiety, fear, etc.), while the other regulated what a person perceives as meaningful (e.g. production of concepts and language). “What’s most remarkable is the fact that the networks for emotion and meaning are coordinated by a control centre made up of six genes,” notes Elisa Díaz de la Guardia-Bolívar, the other co-lead author of the study. “It is particularly interesting that we found that the six genes of the control hub are highly preserved throughout evolution, from single-celled organisms to modern humans. This finding confirms their beneficial role in regulating the functioning of all forms of life on Earth,” she adds.

Identifying these gene networks and the control hub regulating gene expression in humans has practical value because it shows how people can improve the quality of their health, happiness and overall quality of daily life, despite the challenges and stresses we all face.

The UGR’s Igor Zwir explains: “In previous research, we found significant differences in well-being between people in the three personality groups, depending on their

level of self-awareness. Specifically, those with greater self-awareness (the creative group) reported greater well-being compared to the organised and unregulated groups. We have now shown that these levels of self-awareness are also strongly associated with the regulation of gene expression in the same order (creative > organised > unregulated). This suggests that a person can improve their health and well-being by cultivating a more self-transcendent and creative outlook on life."

However, he cautions that it remains to be confirmed whether the regulation of gene expression through interventions that enhance self-awareness is the mediating factor in the association between self-awareness and well-being. Nevertheless, treatments that promote greater self-transcendence and mindfulness have also been shown to contribute to improvements in all aspects of health, including physical, mental, social and spiritual well-being. It is therefore plausible that the regulation of gene expression is the real mediator in this association.

As the researchers predicted, certain types of genes, such as transcription factors, microRNAs and long non-coding RNAs, showed extensive enrichment in the 4000-gene integrated molecular network. However, the most significant enrichment was observed in a group of RNAs that are thought to have played a crucial role in the origin of cellular life. These RNAs have the ability to form membraneless compartments and carry out chemical reactions, allowing them to adapt rapidly to stress. This process, known as liquid-liquid phase separation (LLPS), creates a comprehensive bioreactor in which the chemicals that are essential for life can be synthesised.

"We are delighted to discover the important roles of different types of genes in health and personality. It is amazing to see that evolution has preserved genes that are thought to have been important in the origin of life, allowing for the increasing plasticity, complexity and consciousness that we observe in humans. The innovative computational methods used in this project enable us to study complex biological systems in humans in an ethical, non-intrusive and beneficial way, with the aim of understanding how to live healthily," says Professor Cloninger. He adds: "These findings clearly demonstrate that a person's mind and body are deeply interconnected. Each influences the other, so they are not separate. It is important to recognise that our future well-being is not entirely determined by our past or present conditions; rather, we can cultivate our own well-being in a creative process full of open-ended possibilities."

**Contact details:**

**Coral del Val and Igor Zwir**
Department of Computer Science and Artificial Intelligence of the University of

 

Granada (UGR)
Email: @email / igor@decsai.ugr.es
Telephone: +34 958 240 468

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