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ORIGINAL ARTICLE

TRANSDIAGNOSTIC GENE–ENVIRONMENT NEUROECONOMICS: FROM ARBITRARY BEHAVIORAL LABELS TO BIOLOGICALLY ANCHORED CONSTRUCTS

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ABSTRACT: Since the mid-twentieth century, the discipline of economics has undertaken a progressive effort to reconcile the formal elegance of theoretical models with the empirical complexity of human behavior. This trajectory has evolved from Friedman's formulation of "as-if" rationality, in which the predictive power of models was privileged over their psychological plausibility, to Simon's concept of bounded rationality, which underscored the structural and cognitive constraints inherent to decision-making, and subsequently to Kahneman and Tversky's demonstration that departures from rational choice occur in systematic and predictable ways. More recent decades have witnessed substantial interdisciplinary advances: neuroeconomics has elucidated the neural circuits underpinning decision-making processes, behavioral genetics has established that both cognitive and non-cognitive traits are partly structured by common genetic variation, and psychiatry has advanced toward transdiagnostic and dimensional paradigms, as exemplified by frameworks such as RDoC and HiTOP. Building upon these convergent developments, the present article advances the concept of a Transdiagnostic Gene–Environment Neuroeconomics, conceived as an integrative framework in which behavioral constructs are operationalized in quantifiable terms, anchored in specific neural systems, and traceable to polygenic influences. Such an approach enables a more refined characterization of interindividual variability in decision-making and its potential reverberations within macroeconomic dynamics.

Keywords: Neuroeconomics; Polygenic Scores; Transdiagnostic Psychiatry; Delay Discounting; Behavioral Economics; Genetics; Heterogeneity

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A short intellectual history: from the billiard table to the average man

Milton Friedman's well-known billiard-player analogy once captured the pragmatism of economics [1]. It did not matter whether real people solved complex equations; what mattered was that they behaved as if they did. For Friedman, predictive accuracy outweighed psychological realism.

This line of reasoning was later confronted by Herbert Simon under the argument that human reasoning occurs under strict limits denominated at the time as "bounded rationality" [2]. This trend of change became sharper when Daniel Kahneman and Amos Tversky demonstrated that people are not only limited thinkers but deviate from rationality in a systematic and reasonably predictable way [3]. These ideas served as the basis for behavioral economics.

The following theories came from a field currently known as neuroeconomics [4], with the idea of tracing economic behavior back to the neural circuits responsible for various human behaviors, such as, for example, the ideas of risk and reward [5]. However, despite presenting a good initial foundation, this construct still proves to be reasonably incomplete, especially if we consider the major advances in recent years in the genetic understanding of behavioral traits with modern polygenic scores [11-13] and their correlations with distinct neurobiological pathways.

If the discipline of economics continues to find it pertinent to better understand the real causes of human behaviors that lead to different micro- and macroeconomic outcomes (the ultimate object of study), my hypothesis is that the path to be followed must necessarily pass through the better correlation between human behaviors corroborated by neurally plausible mechanisms with strong anchoring in well-established genetic bases, so that only in this way can we come closer to probabilistic models that truly estimate with greater precision how choices are made.

Why 'patience' is not enough: the arbitrariness problem

We can take as an example, for instance, the way economists sometimes talk about "patience." They use it as a shorthand when referring to the habit of favoring future rewards instead of immediate ones. From the standpoint of neuropsychiatry, though, this framing raises issues. "Patience" is not really a distinct biological process with its own pathways; it functions more as a convenient tag than a mechanism. The problem is that a term which sounds intuitive at first glance ends up lacking firm support when examined through the lens of neurobiology.

If the goal is to improve the scientific understanding of collective decision-making, I believe that we need constructs that can be measured consistently, grounded in neurobiology, and anchored in polygenic genetic scores. For example, a construct that fits this definition is what we call in neuropsychiatry and behavioral economics "delay discounting" (DD) [6,7], which can be defined as the tendency to devalue a reward as the waiting time to receive it increases, because: 1) it provides a quantifiable metric; 2) it is related to well-defined brain systems (the prefrontal cortex and the striatum); 3) it demonstrates clear heritability in polygenic genetic studies [11-13].

Psychiatry and the transdiagnostic shift

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In the early days, psychiatry set up its diagnoses mostly for historical reasons, and many of the boundaries now seem pretty arbitrary. Back then, though, they made sense — after all, our knowledge of how the brain works was very limited. The idea was to put people into neat boxes: depression here, schizophrenia there, anxiety disorders in another. But in real life it never worked that cleanly. The overlap between conditions is huge, and it's common for specialists to disagree on which label to use. Updates to the manuals have made the categories more consistent over time, but the bigger problem — whether these labels truly capture what happens in patients — is still unresolved.

Such limitations of the classical categorical systems opened space for new ideas of classification and understanding of neuropsychiatric symptoms, especially with the global initiatives RDoC [8] and HiTOP [9], which began the reformulation of mental disorders as dimensions instead of rigid entities. In this perspective, so-called "transdiagnostic" traits such as anxiety or impulsivity are not restricted to a single disease but rather extend continuously within the population along a broad spectrum, ranging from mild personality traits to full clinical disorders.

Large-scale genome-wide association studies (GWAS) have confirmed that psychiatric conditions in the classical definitions are united by broadly shared genetic roots [10]. On the other hand, when we use transdiagnostic dimensions, we achieve greater individualization of the genetic pathways involved.
If we truly wish psychiatry to have a strong neurobiological correlation and, as a consequence, economic-social relevance, I believe we need to move in the direction of dimensional diagnoses. I emphasize that classical categories may have fulfilled their role, but science is clearly pointing in another direction with recent advances: neurobiology seems to respect dimensions more than categories.

Polygenic scores and social genomics

Over the last ten years, polygenic scores (PGS) have gained prominence [11-13]. At their core, they compress the impact of thousands of common genetic variants into a single number. The variance they explain is modest—covering outcomes such as years of schooling or cognitive test scores—but their value lies in capturing structured patterns. PGS are not deterministic; they reflect probabilities, and their effects shift depending on the surrounding environment. Still, they give economists a way to connect genes, traits, and behaviors with a level of precision that was not possible before.

For instance, one might ask whether differences in household savings across a population stem more from variation in delay discounting [7] or from executive control. Both are transdiagnostic traits shaped by genetic and environmental forces [11-13].

Questions like these serve as useful illustrations, but the larger goal is more ambitious: to rebuild some of the actual economics concepts on a foundation of neurobiological constructs that are measurable in a neural system dimensional approach and identifiable/estimated at the genetic level.

These transdiagnostic traits, which reflect a mix of genetic, environmental, and cultural influences, are not confined to individuals. They could spill over into families and, in some cases, entire economies [14,15].

Imagine a society where people are more inclined to seek short-term rewards instead of waiting for future gains — what researchers call *delay discounting* - for both genetic and cultural reasons. These families would likely save little and depend heavily on credit.

If this tendency spreads across the entire population, it is not hard to see how it could affect the country as a whole, eventually shaping broader economic policies and even decisions on something as central as domestic interest rates.

Likewise, societies with stronger executive control are probably more likely to accumulate capital in a more stable way and, consequently, would tend to trace more sustained growth trajectories. I emphasize that this view is not yet another empirical and unfounded narrative of genetic determinism: it is, in fact, a neuroscientific perspective that seeks to understand and explain the interaction between behavior, genetics, and environment with the maximum tools available, since the resulting interplay of these factors may eventually modulate, to some degree, the institutions that govern the economic life of all of us.

Conclusion

From Friedman's "as-if" view of rationality to Simon's limits of reasoning, and from the catalog of behavioral anomalies to the mapping of neural circuits, economics has moved step by step toward the biological realities of how decisions are made. What lies ahead is not the imposition of another deterministic blueprint, but the construction of probabilistic models anchored in solid neurobiological evidence. Labels like "patience" should give way to constructs that can be quantified, tied to neural systems, and followed at the genetic level.

The central idea of this article is not to reduce human behavior to biological determinism. On the contrary, I hold that economic choices emerge from fundamentally probabilistic dispositions — influenced in the first instance by genetic predisposition, corroborated by specific neural pathways, and subsequently modulated by particular environmental and cultural contexts, in a loop of mutual feedback.

From this perspective, it becomes necessary to adopt a broader concept that integrates this genetic–neurobiological–environmental model, which I suggest being called Transdiagnostic Gene–Environment Neuroeconomics: a discipline biological at its core, yet flexible enough to account, at least in part, for socioeconomic differences and circumstances.

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