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PSYCHOLOGY AND BIOLOGY NEED EACH OTHER

The issue that Laurence Pervin raised in his paper, also present in its title: *The relationship between biology and psychology*, touches one of the challenges psychology has been confronted with at the turn of the 20th and 21st

century. Thanks to highly developed technology in neuroscience and molecular genetics—researchers have received the possibility to enter into the details of neurological and biochemical processes and changes in brain structures occurring when experiencing psychological phenomena and behavior provoked by given stimuli or tasks being under experimental control in laboratory settings.

Revolutionary for entering the mystery about the relationship between brain and mind was the last decade of the 20th century announced by the US Library of Congress and the National Institute of Mental Health of the National Institutes of Health and proclaimed by the US President as the "Decade of the Brain".

The very fact that our knowledge about the structures and functions of such psychological phenomena as for example perception, memory and emotions has developed to an unimaginable size since the time when Hermann Ebbinghaus (1885) conducted his pioneering experiments on memory is due to the discoveries regarding the biological underpinnings of these phenomena. This statement suggests that progress in psychology, especially in studying psychological phenomena directly related to processes and structures located in the brain, cannot occur without referring to discoveries in neuroscience as well as in molecular genetics. But this view is not commonly accepted especially when such sub-disciplines of psychology as e.g., social psychology, cross-cultural psychology or environmental psychology are taken into account. In these fields of research biology is not present or, as exemplified in social psychology, undertakes the first steps to explain social behavior by referring to biology. A lodestar for such a paradigm in social psychology research was William James' conviction expressed over a century ago in his *Principles of psychology* (1890) saying that biology influences sociocultural factors and reverse—"[…] sociocultural factors influence neurophysiological processes underlying psychological phenomena" (Cacioppo & Berntson, 1992, p. 1019). On the other hand, biology including neuroscience and molecular genetics, has effectively developed without referring to psychology unless biological processes or neurological structures were studied which refer to human (animal) behavior and especially to psychological processes being typical for human beings (such as e.g. the self). Such studies cannot be conducted without psychological knowledge.

When discussing the relationship between biology and psychology Pervin has proposed three views referring to this issue. They may be presented as follows:

— Psychology and biology are separate disciplines.
— Psychology and biology as disciplines competing with each other.
— Psychology and biology refer to different levels of explanation.

One has to agree with Pervin's view since it grasps most of the discussions and struggles around the "biology-psychology" issue at least since the time when Francis Galton (1883) formulated one of the mostly quoted and provocative question "Nature or Nurture? However, I would like to add a fourth view which has strong support in hundreds of findings recorded in experimental, especially under laboratory settings. It says: **Psychology and biology need each other**.

The fourth view is based on the assumption that psychology and biology are separate disciplines but as such they should not compete with each other and rather be considered as being supportive or complementary one to the other.

If we assume that psychological phenomena cannot be reduced to biology but at the same time are not fully understood when ignoring biology, then an essential question arises: What is the essence of these qualitatively different phenomena which have—as commonly accepted—their location in the brain; this being especially transparent when studying such phenomena as perception, attention, memory or temperament? Psychological phenomena are immaterial entities but their bases are located in the brain, which means that they cannot be disembodied. As such they have a status of **emergent properties** resulting form neurobiochemical processes taking part on different levels of brain structures interacting with each other. One has to agree with Albert Bandura who writes that "Emergent properties differ qualitatively from their constituent elements and therefore are not reducible to them" (Bandura, 2001, p. 4).

In turn, these processes and structures have, to a certain extent, a genetic background but they also develop under the influence of reciprocal interactions (transaction) with broadly understood environmental factors, including social ones. Psychological phenomena, whatever they are, as being immaterial cannot be located in the genes. It is the neurobiochemical background underlying psychological phenomena which is genetically determined and which in interaction with environmental factors increases or decreases the probability that individual-specific behaviors and psychological processes and states occur. This position corresponds with the view of Carey and Gottesman (2006) when explaining the roots of antisocial behavior. The authors state: "We accept as a given that there is a noteworthy genetic influence on ASB (antisocial behavior—J.S.) not matter how it is defined […] but so is the impact from the

environment, broadly defined to include pre-and post-natal, physical (e.g. anoxia, fetal alcohol syndrome, or crack) as well as psychosocial (e.g. quality of parenting, ethnic culture, or religion) elements" (p. 342).

As a researcher interested since the beginning of my academic career in studying individual differences, especially in temperament, understood beside character as an element of personality, I am strongly bound with the construct of trait, which has also an ontological status of an emergent property (Strelau, 2008). Figure 1 illustrates the ontological status of a personality (temperament) trait.

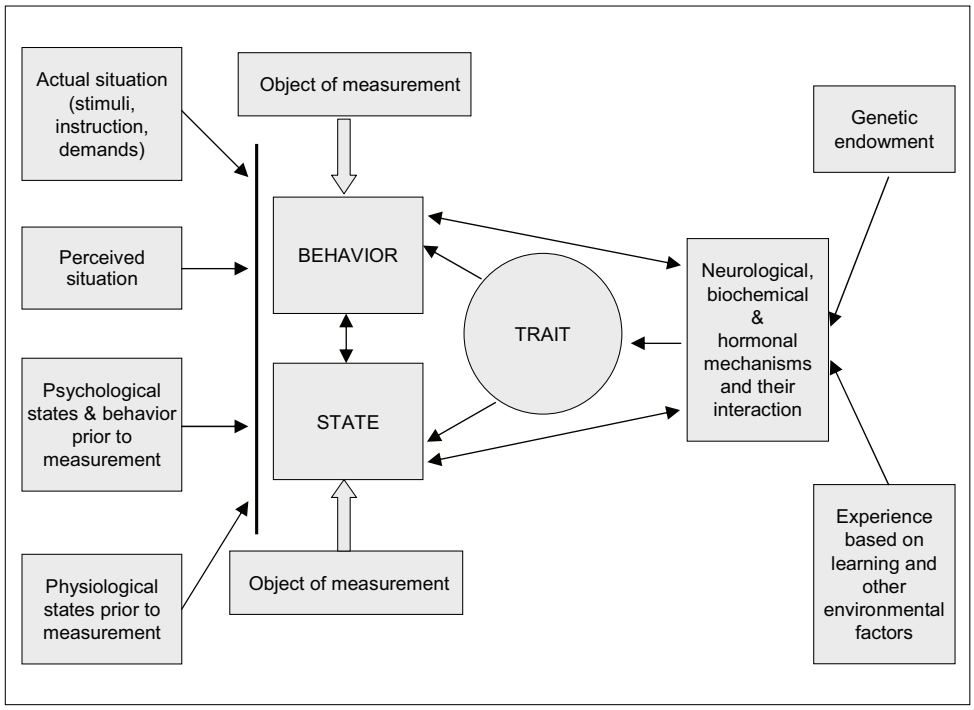

Figure 1. The hypothetical status of traits. From: "The Concept and Status of Trait in Research on Temperament" by J. Strelau, 2001, *European Journal of Personality*, 15, p. 319. Copyright 2001 by John Wiley & Sons, Ltd. Reprinted with permission.

Trait—understood as a generalized tendency toward specific behaviors manifested in various tendency-consistent situations or settings—is determined by internal mechanisms, inborn or acquired, but cannot be reduced to these mechanisms alone. The trait is the outcome of specific connections between many internal mechanisms and has a discrete status, expressed in the

tendency to behave (react) in a specific way. This tendency, which has a genetic background, can be modified by ontogenetically developing physiological mechanisms and external contingencies (such as learning and other environmental factors) that affect the individual from the moment of conception (p. 79).

Under individual-specific, repetitive and long-lasting, psychological and social experience neuronal networks and synaptic connections of the brain undergo changes, thus leading, together with the individually molded expression of genes, to a unique biological foundation of psychological traits. As postulated by Curtis and Cicchetti (2003, p. 777): "Neuronal and synaptic modifications not only exert a prominent role in initiating and maintaining the behavioral changes that are provoked by experience but also contribute to the biological bases of **individuality**, (underlined by J.S) as well as to individuals being differentially affected by similar experiences".

Such an understanding of the ontological status of traits differs essentially from Costa and Mc Crae's (2001) view on this issue. When describing the status of the big five factors as defined by the authors, they declare that these factors "[…] are not a product of the environment, neither dispositions, which originate as a result of dynamic interaction with the environment, but they are independent forces which are guided by their own, internal development". By the way, such an understanding of the status of traits considered as immune and exclusively biologically determined phenomena creates a theoretical background for socially and educationally detrimental policies.

As a trait-oriented personality psychologist, especially interested in studying temperament as located in a very broad context, including its biological background I am looking with submissiveness on the hitherto existing discoveries regarding the biological roots of temperamental traits. Although the majority of temperament researchers (see e. g. Cloninger, 1997; Eysenck, 1991; Gray, 1991; Rothbart, 1995; Kagan, 1994; Strelau, 1998, 2008; Zuckerman, 1991) is deeply convinced that temperament cannot be understood without referring to biology—we are still far in making unequivocal conclusions regarding the links between the neurophysiological mechanisms underlying temperamental traits. There are several reasons creating obstacles in making unambiguous statements regarding the relationship between temperament and biology. I would like to mention some of them as referred in my previous publications (see Strelau, 1998, 2008, submitted for publication).

— Many temperament scales having their roots in different theoretical conceptualizations correlate to a high extent with each other. For example,

in one of our studies (Strelau & Zawadzki, 1997) we found that such scales as Extraversion (EPQ-R, NEO-FI), Sociability, Activity (EAS-TS), Activity-general, Approach-withdrawal, Quality of mood (DOTS-R) have loadings varying from 0,64 to 0,80 on one factor identified as extraversion. The high loadings may be explained by the fact that among item pools from different inventories there are many items which refer to the same or very similar categories of behavior, thus they share a common variance. This is one of the reasons why it is difficult, if possible at all, to discover trait-specific biological mechanisms. The only statement which seems to be valid is, that all of the scales mentioned above refer to traits which have their biological roots in the level of arousal or arousability (autonomic or central).

— Temperament theories that specify very clearly the neurobiochemical underpinning of postulated temperament traits are far from successful verifications of such kind of statements. To give an example, let me refer to the psychobiological model of temperament developed by Cloninger (1997) which has gained increasing popularity over the last decade. According to the author, one of the four temperamental traits—novelty seeking (apart from reward dependence, harm avoidance and persistence) is mediated by dopamine, considered by the author as a trait-specific neurotransmitter. Several number of studies (see Strelau, submitted for publication) based on allelic association expressed in correlations between phenotype and particular allele (QTL) were aimed at answering the question, whether an allelic association exists between functional polymorphism in the dopamine (DRD4) and novelty seeking as measured by the Tridimentional Personality Questionnaire or Temperament and Character Inventory. The separate number of reports is almost equal in that they support or do not support or even contradict the allelic association between DRD4 polymorphism and novelty seeking. The contradictory results regarding this relationship—and this refers also to other temperament traits as related to neurotransmitters—are especially evident when meta-analyses have been conducted in which temperamental traits have been related to candidate genes such as: 5HTT, DRD4, DRD2, and DRD3 (see Strelau, submitted for publication).

— The neurotransmitters postulated as creating the biochemical background of given temperament traits are not temperament-specific. Thus, e.g., dopaminergic activity considered by Cloninger as the biological basis for novelty seeking correlates to a similar extent with impulsivity, extraver-

sion, approach-withdrawal and sensation seeking (see Strelau, 1998). As stated by Petra Netter (1991, p. 152): "It must be kept in mind, however, that one transmitter or hormone is involved in many functions, and conversely, one type of behavior is mediated by a variety of transmitters and peripheral biochemical variables."

The lesson based on studies regarding the relationship between temperament traits and biology teaches us that the biological underpinning of psychological phenomena is very complex and probably in the psychological literature few examples, if any, can be cited showing that a given behavior, psychological process, state or trait and individual differences in these respect can be explained by referring to a single neurophysiological process or gene, taken separately from other biological and environmental variables. It does not mean that researchers interested in searching biological backgrounds of the phenomena under study are treading on the wrong way when concentrating on single biological mechanisms unless they are aware that the way is a long one with many bifurcations and blind pathways. We are still far from discovering the full repertoire of biological mechanisms (inherited or acquired or molded during ontogeny) underlying any behavior or trait.

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BIOLOGY—PSYCHOLOGY: INTEGRATION FROM THE PERSPECTIVE OF NATURAL GESTALT PSYCHOLOGY AND THE SYNERGETIC APPROACH

COMMENTS ON L.A. PERVIN'S PAPER

The currently debated relationship between biology and psychology seems to be similar to the one which Max Werteihmer, the founder of gestalt psychology, experienced during his time of studies. Kurt Koffka (1935, p. 18) mentioned that Wertheimer wrote his doctorate dissertation during a climate of dilemmas plaguing German psychology. On the one hand, for him it was an attractive psychology performed according to the methodological assumptions of physics and physiology in W. Wundt's experimental laboratories, on the other hand he did not want to resign from the German idealistic tradition and its intellectual climate of *Geisteswissenschaften*, the humanistic and moral sciences dealing mostly with understanding the meaning or significance of culture.