Eustress and Distress: Neither Good Nor Bad, but Rather the Same?

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1. The Eustress Paradox: Everyone Talks About It but No One Really Knows What It Is

Nowadays, the term “stress” is used in so many contexts that it is extremely difficult to provide a simple explanation of the meaning of this term. The interpretation of the term “stress” is highly dependent on the field, with possible meanings including “reaction” (physiology), “negatively perceived factor or situation” (psychology), or environmental factors affecting the cell or organ or body (biology). While some of these meanings denote external factors, others denote the reaction of the body, a situation that confusion and also a gap in understanding between the humanities and biomedicine. The term “stress” is also often used in clinical medicine as a pool of risk factors for various diseases that include a psychosomatic component or as an explanation for diseases whose pathophysiology is poorly understood. Clinicians sometimes operate with “good stress” and “bad stress” concepts that aim rather to denote the intensity of a stressor than the nature of the bodily reaction to the stressors.

In these fields, the terms “eustress/distress” are widely used and often misinterpreted. The paper is therefore oriented to disease-associated phenotypic trajectories and intends to explain the misconceptions in the use of stress from this viewpoint.

Overall, the eustress/distress paradigm is used in many fields and contexts and the theory behind it substantially differs across fields. To understand the intended meaning of this ubiquitous term, we first need to understand its history, too. To avoid further confusion, mainly with notions of stress used in evolutionary biology and ecology, we strictly refer to stress in humans and its clinical/psychological implications.

Initially, the syndrome that would soon be called “stress” covered the non-specific response of an organism to a wide range of environmental factors including physical, chemical, and biological ones, under the wide umbrella of “general adaptation syndrome.” In fact, Hans Selye published his 1936 article under the title “A syndrome produced by diverse nocuous agents” and described multiple manifestations of the defined syndrome, including thymicolympathic involution, gastric ulcers, lipid discharge from the adrenal gland, and loss of chromaffinity in the medulla, that Selye established as a unifying non-specific adaptive response to various kinds of agents. The word “stress” first occurred in human and animal physiology in 1946. In 1975 John W. Mason suggested that Selye’s work (influential as it was) had led many researchers logically to assume that usage of the term...
“stress,” in a biological sense, began historically with Selye’s publications—an idea that Mason rejects.[2] One way or another, it was Hans Selye who introduced the term “stress” to the general public and who incessantly explained its meaning to a broad audience around the world.

It took Hans Selye almost 4 decades to specify that not all stress reactions are equivalent, and that observed differences may be the outcome of not just a varying intensity of stressors themselves but also of differences in the subject’s perception and physiological response that go deeper than just the inherent reactivity of the human body. Selye, often prone to create new names and concepts, although not always very consistent in using them, introduced the terms “distress” and “eustress” in the early 1970s in order to distinguish whether the stress response was initiated by negative, unpleasant stressors, or positive stimulating factors.[3][4]

At that time, he came to the understanding that the division of stress into eustress and distress provided a major distinction and discovery relevant not only to the relatively small research community but also to the general public, and he published his findings in a book specifically focused on this theoretical concept. In this book, Stress without Distress[3] and the subsequent autobiographic The Stress of My Life: A Scientist’s Memoirs,[4] he started to emphasize that “stress is not what happens to you, but how you react to it.”[3][4]

While Hans Selye considered the definition of eustress and distress the crucial findings of his whole scientific career, little attention has been paid to the eustress–distress differentiation in the scientific literature ever since. While there is a large body of evidence on distress and its effects on human and animal health, papers focusing on the effect of eustress are scarce, as well as papers dealing with the differentiation between eustress and distress. Moreover, some authors hold the view that the attention paid to eustress definitions and the application of the theoretical knowledge to practice is completely insufficient[5–6] and consider the whole concept incomplete and in need of revision.[5]

The basic idea of Hans Selye in 1974 was that negative stress, that is, distress, suggests the individual would experience negative emotions and physiologically measurable adverse effects on physical levels, such as most of the psychosomatic phenomena, while positive stress or eustress would stimulate the individual to feel happy or motivated. While there is no problem in understanding the negative effects associated with distress, it is quite unclear what Hans Selye had in mind when defining eustress, as we discuss in more detail in the next section.

To evaluate the prevalence of the terms “eustress” and “distress” in the scientific literature, we conducted a search in the Web of Science (WoS). As of February 6, 2020, there was a total of 276 items in the WoS in response to a search for “eustress,” while there are 246 726 WoS items when the search is for “distress.” First, this shows that in particular “distress” is a very common term. Second, although the number of direct hits for “eustress” is small, the usage of “distress” automatically implies the notion of eustress, otherwise, one would just call it stress. We conclude that, given the widespread use of at least “distress,” a critical discussion of the terms eustress/distress will be useful. The following sections focus mainly on definitions of eustress/distress and then present implications and recommendations for their usage.

2. First, the Criteria for Eustress/Distress Have Always Been Poorly Defined

We quote from Selye’s paper from 1976:[6, p.15]

In everyday life we must distinguish two types of stress effects, namely, eustress (from the Greek eu or good – as in euphony, eulogy and distress (from the Latin dis or bad – as in dissonance, disease, dissatisfaction). Depending upon conditions, stress is associated with desirable or undesirable effects. In view of these conditions it is also quite obvious that there cannot be different types of stress, although the effects of stressors are almost invariably different.

However, in the same year Selye wrote elsewhere:[7, p.74]

We must, however, differentiate within the general concept of stress between the unpleasant or harmful variety, called distress and eustress. During both eustress and distress the body undergoes virtually the same non-specific responses to the various positive or negative stimuli acting upon it. However, the fact that eustress causes much less damage than distress graphically demonstrates that it is “how you take it” that determines, ultimately, whether one can adapt successfully to change...

In the work of Hans Selye, there is sometimes uncertainty as to whether eustress refers to the action of positive stressors from the surrounding environment or the positive reaction of the body itself. This conflation of cause and reaction inevitably leads to misconceptions and misunderstandings when the terms “eustress” or “positive stressors” are used because sometimes they denote simply the factors promoting positive perception of an event, whereas in other situations they denote the positive bodily reaction or positive perception of that reaction.

Contrary to this limited approach, others, for example, Milsum et al., provide a wider definition of eustress as a “full system that includes the psycho-social dimensions.”[8] In the work by Milsum et al., “stressors” are defined as potential producers of stress, and are illustrated in the physical, psychological, and social domains, while so called “destressors” are similarly considered to act in the opposite direction and mainly associated with lifestyle. However, even though the concept by Milsum et al. incorporates the idea of complex homeostatic relationships within the body, it does not say much specifically on how to quantitatively distinguish eustress from distress or, even more important, how to measure it. Furthermore, Milsum’s framework adds a further layer of confusion to the definition of eustress because, contrary to the original concept, he considers eustress to be a condition rather than a process. Lazarus et al.,[11] on the contrary, employ an idea of cognitive input into the final reaction, suggesting that eustress is a positive cognitive response to the cognitive evaluation of a situation that can change during the time a stressor is present. Edwards and Cooper go even further and consider eustress the positive discrepancy between perception and expectations (highly subjective to an individual).[12] However, the cognitive appraisal as well as emotional aspects of the stress response do not make it possible to explain the whole spectrum of stress reactions as we will discuss further. For example, the exposure to accumulating pollutants within the body may be associated with significant cellular/tissue stress and may lead...
to decreased longevity, but may not be associated with either cognitive appraisal or emotional response.

The third approach to defining eustress, which is highly pragmatic and currently dominating, was developed on the basis of the Yerkes–Dodson law and suggests that eustress is beneficial for performance until the optimum level is reached and after this peak performance declines, a process that is associated with distress.\(^{[10]}\) However, defining eustress simply by peak performance may be too simplistic because it is easy to find many examples of stimulants that can increase peak performance, but are very detrimental in the long run, for example, methamphetamine, cocaine etc.\(^ {\text{[11,12]}}\)

Here we consider three different scenarios to demonstrate that the term “beneficial” is very interchangeable and can be perceived in very different ways:

Scenario 1 refers to a case of 25-year-old man exposed to a rollercoaster ride. While the ride itself can be perceived as pleasantly exciting, the changes in pressure gradients in brain vasculature cause a dormant brain aneurysm to rupture, and the man dies shortly after the ride finished. While the whole event of the ride was perceived in a pleasant elating way, the overall effect of the ride on the health of an individual is catastrophic both from a long-term as well as short-term perspective. The individual perception of the roller-coaster ride as a pleasant experience has nothing to do with “adversity” of the consequent health outcome. The good-or-bad nature of the bodily reaction to the roller-coaster ride can be determined only when the final outcome is known.

Scenario 2 refers to a 40-year-old banker working in investment banking and maximizing his working performance. This banker frequently abuses cocaine, is sleep-deprived and suffers from a huge workload, but is also very successful and rich. Even though cocaine abuse is generally considered adverse for human health, it helps the banker maximize his performance to a level that is above what average human physiology would allow. The banker dies at the age of 47 of myocardial infarction, which is a risk he accepted at the very beginning of his career. Can we consider cocaine abuse distressing at this point? While it may have reduced his lifetime, it also enhanced performance and improved his socioeconomic status. It seems intuitive to define the benefits based on longevity, as most of us want to live long. However, if we trade longevity for increased performance or success, this definition becomes moot.

Scenario 3 refers to a 25-year-old man who is mobbed at work. While mobbing will definitely be perceived as distressing and unpleasant, leaving our individual with significant psychiatric morbidity, the presence of our individual in the given working group still gives him good access to resources for his work that makes the presence in the group more attractive to him. The presented individual seeks professional help, and with this help, he substantially improves his strategies and subsequently is capable of diverting the whole mobbing impact from himself while taking on exercising classes and substantially losing abundant weight. While undoubtedly, the mobbing was perceived by our individual as negative and induced the bodily reactions that we generally associated with “negative” stress, from the long-term perspective the whole ordeal led to personal growth and improvement both in health and performance. Again, we are unable to decide on whether the whole situation was “good or bad,” without having knowledge on the final outcome or at least without having a certain timeline that would make it possible for us to decide on the long-term and short-term effects.

The most common problem with the definition of eustress stems from the fact that many authors use the term “stress” interchangeably to designate a reaction to a stressor as well as the stressor itself. The same problem affects eustress: in the original meaning, eustress is a positive reaction to a stressor, not the cause of this reaction (i.e., the stressor itself).

3. Second, Even If We Employ the Concept of Eustress Being Defined Based on Performance, a Demarcation Line between Eustress and Distress Is Practically Non-Existing

The conflation of eustress with positive emotional perception of an event or enhanced cognitive performance leads to highly heterogeneous results of similar study designs. This is even further complicated by the fact that emotions, as well as cognitive performance, can change over the time during which the stressor exerts its effects. From a physiological perspective, it seems that the body does not develop two separate reactions, but only one with the resulting phenotype being shaped not only by the parameters of the stressors, but also by the inherent characteristics of the individual as well as by his or her position on the aging timeline.

The ultimate point of debate lies in the fact that the good or bad character of the response occurs only in retrospect when the reaction has led to health outcomes. This is inherently later than the event itself (whatever the event is), so at the time of the reaction, it is simply impossible to decide whether the reaction serves its purpose (whatever this purpose is, e.g., enhanced longevity or increased performance) or not. In our previous work, we presume that the human phenotype, including all aspects of health or diseases, develops as a combined effect of three main factors, genetics, environmental stimuli, and aging. However, the development of these phenotypes over time is not random but follows a certain trajectory, for example, before a healthy individual starts to manifest a full spectrum of symptoms for a given disease they have to first develop several transitory phenotypes in a logical and causal fashion.\(^{[31]}\)

From this perspective, the term eustress will make sense only when assessing one such trajectory at a time, but it does not make sense when all trajectories leading to an infinite number of different health outcomes are considered at the same time. For example, the given adaptation reaction can lead to one adverse health outcome, but can be protective toward another health outcome at the same time, which makes it impossible to decide on the single nature of the beneficilaty of the reaction at a single moment. A good example of this may be glycemic control. Stress hyperglycemia is common in critically ill patients and appears to be a marker of disease severity.\(^{[14]}\) Even though blood glucose at admission as well as mean glucose level during a hospital stay are strongly associated with patient outcomes in some patients, a critical review of the literature shows that the tight glycemic control in both ICU and non-ICU patients do not always improve healthcare outcomes.\(^{[15]}\) It can be therefore speculated that while one
trajectory the levels of glycemia may be positively associated with reduced survival of an individual, the increased levels of blood sugar can be actually protective and adaptive response enhancing the survival on another one. The actual decision on whether the achieved levels of glycemia were good or bad for the patient can be only made in retrospect and depend on the knowledge of the actual outcome (survival yes or no) as well as on knowledge of the etiology of the disease. From the perspective of the performance-oriented theories of stress, it is impossible to draw conclusions on the actual performance achieved without the knowledge of the final outcome.

However, the most important problem of the eustress concept is that reactions to many stressors can be described as eustress or distress based purely on a considered time point. A good example of this is a reaction to a common stressor in academic life: tight deadlines. Upon hearing about a new tight deadline, many people experience discomfort or even anxiety, at this time point, the reaction of organisms to tight deadlines could be classified as distress. However, close to the deadline itself, it is common to report increased productivity, and thus at this time point, the reaction of organisms to tight deadlines could be classified as eustress. Immediately after the deadline, the situation changes again as work under pressure made people feel exhausted and even reduced their productivity, at this time point the reaction of organisms to tight deadlines could be again classified as distress. Furthermore, a long-term effect of stress induced by tight deadlines is likely detrimental on health as well as performance, that is, distress.\[16\]

So far, it has not been generally possible to define a clear line between what is eustress in terms of a beneficial reaction of the body and distress perceived as bodily reaction leading to illness. Such a reaction should be, in that case, drawn for every future phenotype separately, as a trajectory from one phenotype may continue toward multiple future phenotypes, and it is impossible to estimate the future phenotype without knowledge of the intercalated phenotypes. More clearly, one phenotype may be beneficial from the perspective of one future illness, while it may be highly disadvantageous from the perspective of another.

4. Third, No Attempts Have Been Made to Distinguish Eustress from Distress Based on the Strength of the Stress Response or Based on Intensity of Stressor

Centuries ago, the father of toxicology, Phillipus von Hohenheim (also known as Paracelsus\[16\]), concluded that it is the dose that makes the poison.\[17\] Despite the dearth of scientific data in the 1500s, Paracelsus suggested that anything can be toxic in high doses and, conversely, that many poisons are not toxic in low doses. This applies well to different sorts of factors eliciting stress responses as well as their combinations. It has been suggested that the response to stress in the human brain may switch from enhanced resistance to increased vulnerability with a shift in either stressor dose or duration. The dose and duration are generally the key elements to exposure to substances from the environment and detrimental effects from any substance or other type of stressor should not be generally attributed to the “harmfulness” of the substance without precise knowledge of exposure, as it is often the case.

In contrast to Selye’s idea of clearly distinguished good and bad effects of stress, we believe that stress produces a string of phenotypic trajectories that are potentially good or bad, based on the final health outcome that we are investigating. In other words, the phenotypes produced due to stressors of varying intensity, type, and duration are not clearly good or bad as their nature depends on the retrospective interpretation based on our knowledge of the final outcome. However, this final outcome has been inevitably shaped not only by these investigated stressors, but also by all preceding and following stressors as well as by the inherent characteristics of the organism, hence rendering an interpretation of any single stressor’s effects nearly impossible. A good example is immunization. Animals as well as humans immunized against a deadly pathogen such as rabies, smallpox, are able to survive infection by this pathogen, often even without any symptoms, while their non-immunized counterparts are killed by the same pathogen. Therefore, the same stressor can have widely different effects.

To provide a clear resolution of the good-or-bad effects of stress, it seems imperative:

1) Not to assess a single phenotype in relation to a single stressor but to provide a string of phenotypes linked to the investigated health outcome.

2) To provide an alignment of these trajectories that involve certain stressors or health outcomes of interest into pipeline models that better describe the link between possible stressor and late health outcome and that will involve not only exposure to the stressor, but also knowledge about the lifetime pathway of health of an individual, including his/her inherited traits as well as detailed history of previous events relevant for a given health outcome with the individual aging information.

3) Not to mistake the beneficial nature of a stressor for its low intensity and short duration (hormesis—all factors can be fatal at certain intensity), and not to mix short- and long-term effects of a stressor.

4) Not to mix eustress with positive effects of previous exposure to stressor, known as preconditioning. If we follow the original meaning of the concept of stress derived from the general adaptation syndrome, it follows that eustress should also be general, that is, it should exert a generally positive effect on duration and/or quality of life (again without clearly defining what positive means here). On the other hand, preconditioning should provide specific protection against specific stimuli or, in specific tissues, no matter what the consequent effects are. For example, a short duration of ischemia is known to protect the heart against the adverse effect of longer period ischemia;\[18\] however, that does not mean the short duration of ischemia generally has positive effects.

5. Conclusions and Speculations

Based on the available body of evidence, we believe there is no such thing as eustress. The adaptation reaction is not good or
bad, and its effect on longevity or performance depends on a plethora of other interactions of the body with the surrounding environment (not only with the stressor itself) as well as on the whole history of these interactions since conception, or even before that at the level of gametes. We therefore propose that the term eustress should be abandoned as confusing and should be replaced by universal use of the term stress instead.

A recent paper with the key word “distress” is titled “Association of prenatal maternal psychological distress with fetal brain growth, metabolism, and cortical maturaion.” In this title, the change of “distress” to “stress” would not change the meaning the paper conveys. Moreover, even in psychology, the change of “distress” to simply “stress” does not seem to pose necessarily a problem, as can be demonstrated by replacing “distress” in the title of a recent paper on “Associations between maternal physiology and maternal sensitivity vary depending on infant distress and emotion context” with “stress,” again without substantial change in meaning.

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Conflict of Interest

The authors declare no conflict of interest.

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J.B.-V. and P.L. co-developed the central idea. M.S. provided supervision and stimulating questions. All authors co-wrote the manuscript.

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