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On Resilience: Psychological, Physical, and Physiologic – Leveraging the Challenged Life Matrix to Explain and Manage Unintentional Stressors

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Abstract

The concept of stress was first introduced by Hans Seyle in the 1930s, giving way to our model of the General Adaptation Syndrome (GAS). The sciences that emanated from these considerations were broad-reaching, from endocrinologic, to neurohormonal, through the immune system, clearly the musculoskeletal system - with a systemic throughline of inflammation. While life is arguably less stressful (unintentional stressors) than it was in the 1930s, intentional stress is now omnipresent and increasingly a topic of health and wellness routines. What is intentional stress, though? How does "it" help us to mitigate the effects of the unintentional stress in our lives? In this paper, we will introduce The Challenged Life Matrix, with particular considerations for a life approach balancing the unintentional stressors with intentional stressors by examining their effect on one another. Related, this article will give consideration to society's disappearing role of rest, to recover from each of these subtypes of stressors.

Keywords: Stress, Periodization, Allostatic Load, Hormesis, Senescence, Resilience.

Introduction

Is life on Earth more stressful now than it was 20, 40 or 100 years ago? Are you hearing recommendations to "limit stress", but find this to be an absurd if not impossible recommendation? Perhaps the stress in our lives is just different than it was decades ago. Perhaps the frequency and magnitude of stress is the same, yet we are permitting ourselves to talk about stress more now, than our cultural norms might have allowed generations ago?

The alternative is possible. Stress levels and frequency may in fact be elevated across the world? One reason that stress may be on the rise is that it is omnipresent and expected now more than ever. The baseline "norm" of stress has increased for us all. We experience stress in getting kids to school, within our commute, during our day at work, and then back again with meal planning and bedtime. Stress' omnipresence includes work and financial, family and relationships, academic, athletic, social/community, and more. While this might not sound different from decades ago, it may both feel different and be experienced differently as a function of our compared lives (social media) and access (phones).

Although stress can impact lifespan, it is possible that our expanding lifespan (people continue to live longer on average), yet the reality of increasing lifespan may not be an accurate reflection (correlational) on the level of stress across the world. With the understanding that life spans across the world are not expanding as fast as they once were - predicted lifespans in most countries are indeed reapproaching an all-time high (Jugran, 2025). The operative word being "reapproaching" as the all-time high was achieved just prior to the pandemic. Additionally, and likely not coincidentally, literacy (reading) rates are at an all-time high, while poverty and food scarcity (hunger and starvation) rates have regional exceptions – both are at an all-time low in global statistics (National Literacy Institute [NIL], 2024-2025; World Health Organization [WHO], (n.d); Poverty and inequality platform [PIP], (n.d)). Is it safe to circle-back now to the question, "Is stress disappearing?"? Are we living in an age of redefining "life balance"? Hardly anyone would suggest that unintentional stress is decreasing across the world, that it is now "low". Is it possible that "today's stress" is different?

Would more unstructured or "down" time to mitigate (control or reduce) stress? Or is there potentially another route by which we can reduce the direct physiologic experience (cost to the body) of stress? The question at the crux of this paper may be restated from the abstract, though, "Can intentional stress reduce the effects of unintentional stress in our lives?" If so, what is the equation – the ratio of intentional stress and rest needed to successfully benefit from programmed intentional stressors?

In 2019, Cathomas et al published, "Neurobiology of Resilience: Interface Between Mind and Body". In their abstract, the Cathomas and colleagues write, "*This review provides an*

update on the current state of research of the neurobiological mechanisms of stress-resilience. We focus on physiological and transcriptional adaptations of specific brain circuits, the role of cellular and humoral factors of the immune system, the gut microbiota and changes at the interface between the brain and the periphery, the blood-brain barrier. We propose to view resilience as a process that requires the integration of multiple central and peripheral systems and that elucidating the underlying neurobiological mechanisms will ultimately lead to novel therapeutic options (Cathomas et al., 2019)."

While Cathomas and colleagues' article is brilliant, the physiology and cellular-level mechanisms may leave readers without practical applications. The present article is written to fill this very gap and answer the salient questions and "solutions" for stress. Is stress always bad? Can we mitigate stress, or can we only hope to avoid stress? What are the body-wide (systemic and health condition) consequences of persistent stress? As for the solutions, this article attempts to provide the translated science behind stress mitigation leveraging practical applications in the form of tools to manage unintentional stress.

There is so much research on this topic that it would take years to catch up or keep up if you attempted to consume it all. Volume is one of the problems. Wading through the science takes time even when the science is in full consensus agreement, which it is not. An additional barrier preventing us from benefiting from all of this research is the technical jargon, equations, abbreviations, pathways and mechanisms. While this is all necessary in scientific writing, this leaves us without practical applications to apply in our lives. What if the intentional stressors that we introduce in our lives could be, as James Clear says (*Atomic Habits, 2018*) attractive, obvious, easy and satisfying? (Clear, 2019) The solutions may not be overly complex and may be more practical than could be expected. In addition, the solutions may in fact be plural - a set of options that we could choose from to personalize our plan. In an effort to help you choose your best options – this article will provide a superficial review of the how and what. How we can reduce the effects of our stress, and what happens in the body.

Work-Life Balance

Have we shifted the conversation from "work-life balance" to something different altogether? Suspend your full judgement for a moment as you consider that the term "work-life balance" is now insufficient…if for no other reason that some people experience a majority of their unintentional stress - in the "life" part.

Perhaps the optimal equation is no longer work and life in balance (spoiler alert: no math required) but is now "work-life-workout" balance. Meaning, we have solved work-life balance by adding the variable of exercise (an intentional stressor)! We *can use workouts* to balance work and life-based stress. Well… not so fast. There are two caveats to consider here. First, the workout itself can introduce unintended stressors which will be detailed. Second – exercise (workout) is not the only pathway to mitigate stress.

Before we take a more detailed look at the "how" (the physiology and interaction of both unintentional and intentional stressors), let's take up that comment introduced above. Intentional stress may be taken to extreme, may be poorly-timed, or may in some cases be wholly incapable of mitigating a particular event that you are experiencing. Just as you have heard the saying, "you cannot exercise your way out of a bad diet", the same can be said for a stressful life. Additionally, consider here the concept of "overbalance" that will be expanded-upon later in the article. Meaning, in the pursuit of a balanced life, we may in fact "overbalance" by chasing everything that we are doing with degrees of perfection and structure and leaving little room for spontaneity and serendipity? It is possible that especially in Western cultures that we have valued intentional stress to the point that this too can be taken to an extreme in the forms of injury, systemic damage, and "stress" in an effort to program more healthspan into our lives. We can stress so much about perfecting our lives on the topics of exposure to microplastics, diet, exercise, sleep hygiene, social connectivity, creativity and more – that these pursuits become our own undoing. It is possible that Friedrich Nietzche's (1888, *Twilight of the Idols*) paraphrased and translated comment, "What doesn't kill you makes you stronger." has been over-used and has now outlived its utility (Nietzsche & Levy, 1912). We may now be in a time wherein *what makes you stronger may kill you*. However, in this "golden age" of posting and boasting – we have now arrived to a society that experiences the stress of missing a workout!

Whereas it was once considered healthy and aspirational to have a balance between life and work, many people now find themselves engaged in their professional development and "their brand", posting about work at all hours of the day and night. Others may find themselves more focused than ever on competitive or recreational athletics, even fitness goals – consuming a majority of their former leisure time. Even the "perfect vacation" now may only be a holiday or vacation that is "filled" with activities and adventures, without down time.

This article is intended to stay on point in an effort to provide you with resources and affordances that will inform you about the why (physiologic benefits) and the how (opportunities for intentional stress) in a balanced fashion.

The Challenged Life Matrix

Figure 1 depicts the Challenged Life Matrix (CLM). This main theme of the paper is introduced early if for no other reason than to set the basis from which the reader can begin to see possibilities to mitigate stress and reduce the effects in their own lives.

As alluded in the introduction, we are all likely hearing about the negative effects of stress and hearing about the need to reduce stress. In Figure 1, the "Y" (vertical) axis depicts an increasing amount of unintentional stress as we go from

bottom to top. Along the "X" axis (horizontal) of the CLM, we see the benefits of using intentional stressors as an alternative to "avoiding" stress. As one proceeds from left to right, intentional stressors are increasing.

Each quadrant of the CLM has its own unique trappings and pitfalls. In the upper left-hand corner, a life filled with unintentional stress (US) and little to no intentional stress (IS) can lead to depression and inflammatory disease. In the upper right-hand corner, we have the lived experience of high US as well as high intentional stress (again, for clarity sake abbreviated as "IS"). One may note the term in this quadrant, "Allostatic Load". While this is a complex concept, it is detailed well in Bessel van der Kolk's 2014 book, "*The Body Keeps the Score*" and essentially means that all types of stress must be processed-by and are absorbed-by the body (Kolk, 2014). Clearly, too much "good and bad stress" combined can lead to burnout. The lower right-hand corner describes a life filled with programmed intentional stressors (risk taking adventures with physical exertion and novel experiences), with very little US. While this might seem to be a life filled with spontaneity and excitement - it can lead to overuse injury or even accidents/trauma. Finally, in the lower left-hand corner we have a quadrant that describes the experience of boredom or at worst cortical atrophy (brain is shrinking) and frailty that comes from a life without challenge or stimulus in any direction (low US and IS).

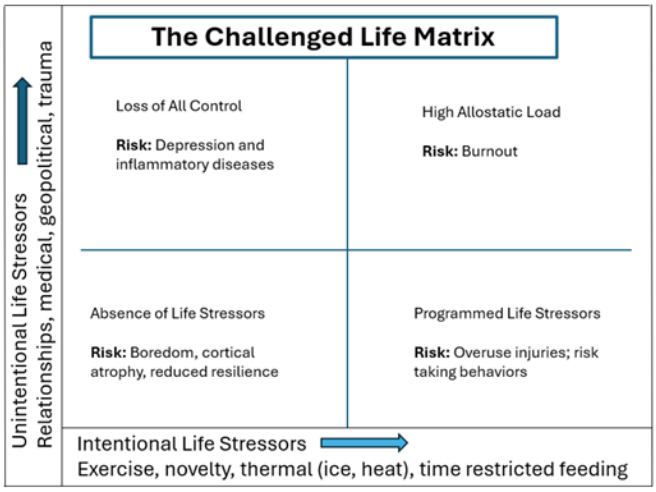

Figure 1: The Challenged Life Matrix

As we continue throughout the paper, the reader will be exposed to our uncomfortable yet evolving relationship with stress, followed by the physiology of unintentional stress. This will be immediately followed by an introduction of intentional stress (IS) and how this is both processed by the body and counters unintentional stress (US). The abbreviations IS and US will be used more from this point forward, as you are becoming more familiar with each. Again, I encourage you to formulate your hypotheses about the interrelationship and noble trappings of IS. As alluded-to in the right side of Figure 1, you may be surprised you to see the ultimate direction(s) of the paper by the time you have read to the bottom.

The History, Physiology and Evolution of Unintentional Stress

In a concerted effort to not wax poetic with a timeline of prehistoric through present-day stress, we will acknowledge that the stressors themselves have changed over time, even if we cannot quantify if the amount has increased or decreased as was deliberated in the introduction. Perhaps we can state with confidence that the most evident changes to unintentional stress have come in the modes or vectors. Unintentional stressors have changed from the end of the 19th century to this first part of the 21st century primarily in the sectors of food scarcity, income/possessions, and in considerations of quality of life (health, friendships, leisure). Unintentional stressors have changed in type over the ages. The upcoming section reveals how our understanding of the systemic effects of stress have evolved and continue to evolve, over the past 100 years.

Our understanding of stress as a phenomenon that is absorbed and is "scored" in the body systems begins with Dr. Hans Selye who first used the word "stress" in the late 1930s in an effort to describe the responses his laboratory animals were displaying, in response to the adverse circumstances delivered. Selye's article in *Nature* described his observations, formulated in the first expression of The General Adaptation Syndrome (GAS) (Jackson, 2014; Selye, 1936; Selye, 1952).

The General Adaptation Syndrome

In the late 1930s and early 1940s Selye explored our physiologic responses to stress and defined these under the term General Adaptation Syndrome (GAS) (Selye, 1952). Broadly, the physiological stages of the GAS include a central role, starting with an alarm that leads to hormone releases and responses. Seyle pioneered the term "adaptation energy" in an effort to explain not only reduced tolerance to other forms of injury during the stage of resistance (see below) but also the eventual demise of laboratory animals after repeated exposure to unintentional environmental pressures, having exhausted their capacity to adapt (Jackson, 2014; Selye, 1936; Selye, 1952).

The General Adaptation Syndrome (GAS) describes the body's three-stage response to stress:

Alarm reaction -"fight-or-flight" response, characterized by increased heart rate and adrenaline release.

Resistance - the body's attempt to recover and adapt to the stressor, while remaining on high alert.

Exhaustion – persistence of stressor leads to resource depletion as the body is no longer able to thrive, grown, maintain homeostasis (Jackson, 2014; Selye, 1936; Selye, 1952).

As our scientific understanding of stress has evolved, more details have emerged. While it is not the intent of this paper to perfectly detail the physiology of unintentional stress, this does deserve an updated expansion, albeit brief. In the nearly 100 years since Dr. Seyle introduced the GAS model, we have

come to understand that the alarm response does not start in the adrenal glands but rather is initiated further upstream starting with a recognition in the brain – signaling the presence (or perceived presence) of a stressor.

At the risk of suggesting that we have now "arrived" with nothing else to learn, the field of stress science is proliferating as we speak. We are bombarded by podcasts, social media posts and advertisements on the negative effects of, on avoiding and on mitigating stress. Still, very little and in this authors' opinion, too little, is written about the positive attributes of stress. In 2025, Emory University physician Dr. Sharon Horesh-Bergquist published *The Stress Paradox* (Bergquist, 2025). Her book includes a review of the systems, modes, applications and dare I say, "life hacks".

Related to the GAS, yet with a different and more contemporary perspective, as noted above, Bessel van der Kolk's 2014 book, *The Body Keeps the Score* helps us to advance the multisystem effects of stress in all forms (Kolk, 2014). Dr. van der Kolk's book is primarily focused on the life experiences of trauma yet does contribute to this space with brain-body interconnections both directions – the how and the why each can affect the other. Readers interested in a deeper dive can look to these two books for more information.

For the purposes of this article, suffice to say that an unintentional stressor does not have to be recognized consciously by the brain to begin the response. A warning signal (trigger) that this environment feels like a past stressful environment can be received by the brain before it is recognized by the mind. Driving near the intersection where you had a recent car accident can cause the body's alert systems (sympathetic nervous system) can be activated. Similarly, an upcoming holiday gathering, a big game (sporting event), possible sighting of a former significant other, and an upcoming job review/academic exam – all of these can be looming in the future and can cause us to process stress that is felt before any of these are recognized. These processes and stress pathways are reflexive. People with a spinal cord injury can experience a reaction (known as autonomic dysreflexia) when they experience pain, an overfilled bladder, or an infection. This often remains unrecognized by the individual yet initiates a sympathetic nervous system (fight or flight) reaction that can be life-threatening by elevating blood pressure to a dangerous level.

Granted, across most instances, a stressor is recognized consciously – leading to activity in the "fear center" of the brain. While this is vastly oversimplified, these collections of cells in the brain are activated and lead to increased alertness and activate a "stress axis" (deeper dive: hypothalamic-pituitary-adrenal) that causes hormones to be released at various parts of the brain, then body. The end result? Cortisol released into the bloodstream. Again, simply put, cortisol elevates inflammation, suppresses your immune system and elevates your blood sugar. Chronic stress is unhealthy – this is in large part the "why".
Our body's efforts to counter the effects of stress are also quite automatic.

Table 1 summarizes the short-term, system-by-system effects of unintentional stress – collectively known as the Adaptive Stress Response. The stress axis (noted above) acts in parallel with another pathway to create these reactions (deeper dive: sympathetic-adreno-medullar (SAM) axis) (Chu et al., 2025). It is noteworthy that these responses are not fixed across all persons or within an individual. Rather, the response can be conditioned, enhanced, or blunted by our beliefs (reframing stress) and experience (conditioning through repeated exposure) to some extent. For readers that prefer a superficial view or understanding, the first two columns of the table would suffice. For those interested in a deeper-dive, consider directing your attention additionally to the rightmost/third column.

Together, these responses largely complement a body-wide effort to regain balance – they are intended to be health-giving. When the stress experience is persistent or long-term, the effects accumulate (cacostasis or allostasis) to the injury or demise of the animal (Hans Seyle's experiments) or person.

Table 1: Short-term Effects of Unintentional Stress (US)

System	Response to Acute US	Deeper Dive
Central Nervous	Increased blood flow Increased alertness Reduced sense of pain	Focused & selective attention are increased Endogenous opiates released for analgesia
Autonomic Nervous (sympathetic branch is activated under stress)	Increased "fight or flight" across the muscular cardiovascular and metabolic (energy storage/ production) systems – preparing for action; as well as the gastrointestinal and system – where blood flow is shunted/reduced	Locus Coeruleus releases Norepinephrine with peripheral organ actions
Musculoskeletal	Increased blood flow, increased muscle tone	Dilation (blood flow) combined with priming neural circuits and neuromuscular junctions – all to prepare for action
Gastrointestinal	Suppressed blood flow Increased gastric acids	Constriction of blood flow to the gut
Immune	Short-term increase in readiness and immune responses – hours (Morey et al., 2015), (Dhabhar, 2008) Rapid rebound to inhibit immune responses and potentially activate latent viruses (EBV, HSV) (Dhabhar, 2008)	Natural killer cells Neutrophils - released
Metabolic	Mobilization of energy storage Relative sparing of systemic processes originating at the liver and kidneys	Gluconeogenesis Lipolysis Reduced detoxification in the liver, kidney filtration
Cardiovascular	Increased heart rate	Stroke volume increases through rate and increased ventricular contractility
Respiratory	Increased respiratory rate	Decreased efficiency of oxygen exchange and respiratory pattern efficiency
Reproductive & Growth	Suppressed	Reduced growth hormone and both major sex hormones

The Physiology and Practical Applications of Intentional Stress

Former First Lady Eleanor Roosevelt was quoted to have said (est. 1936) (Roosevelt, 1960),

"You gain strength, courage, and confidence by every experience in which you really stop to look fear in the face. You are able to say to yourself, 'I have lived through this horror. I can take the next thing that comes along. ... You must do the thing you think you cannot do.".

Was this statement the origin of not only accepting, but welcoming intentional stressors? While her quote was hardly the first to suggest that there may be a conditioning effect to challenging experiences, it was this very sentiment that expresses the spirit of gaining strength through wartimes, in self-sacrifice, preservation, and preparation - so that one can better endure challenging times ahead.

As we learned earlier from the Cathomas (2018) article in the introduction, there is no shortage of science on stress. With just a little searching, readers can find great depth and continuously emerging science even on the cellular levels of the intentional stressor and unintentional stressor interactions. I will spare you the regurgitation of what I do not know or incompletely understand, in the effort to keep this practical.

An important consideration and first line defense in managing stress is found in the work focused on preventing illness – "sickness" in the more classic or conventional sense, as well as mental health – both being forms of illness that become more likely in a body under stress.

It would both be unfair and inaccurate to suggest that we should always rest or always "push-through" at the first signs of a cold? If so, how should we push through? However, it does appear as though there are some general short-term approaches that we can use to stimulate our immune systems and (in some) boost our mental health. In an effort to be brief, this is admittedly superficial and reductive to say that we may be able to use breathing, physical activity, and cognitive strategies to improve our opportunity to fight off both forms of illness (systemic and mental) when we see them in their earliest stages. Please refer to the citations for deeper-dives for more details in mechanisms and why these work in the body and mind. Many of these strategies have a basis in both activating the immune system and the brain's chemistry that would counter anxiety or depression. This research may ultimately help us to describe and maximize both direct effects of IS on US as well as the

indirect IS-US interactions by arresting an illness in early stages giving us a psychological boost, "I can control my own health", known as self-efficacy.

It is important to note that these strategies have demonstrated effectiveness in battling some cancers as well. Additional keywords that a reader may choose to use in deeper explorations could include "cyclic hyperventilation", "positive mindset", and "immune system modulation". The writings and research emanating from the labs of Dr. Aysa Rolls and Dr. Quifu Ma are quite compelling and worthy of keeping an eye on.

Table 2 gives interested readers some of the mechanisms and pathways on a system-by-system basis. While the table is abbreviated, the pathways and mechanisms can be complex. If you need to skip this table – don't stress about it – as there is another more practical table coming up that explains the applications of IS, the "how" we can do this in our lives.

Table 2: Short-term Effects of Intentional Stress (IS) (Scheffer & Latini, 2020; Trivedi et al., 2016; Chen, 2013; Trevizan-Baú & McAllen, 2024; Liu et al., 2021; Fu et al., 2013; Your lungs and exercise (n.d); Orio et al., 2013; Michely et al., 2020; Frazer & Hensler, 1999)

System	Response to IS	Note/terms
Central Nervous	Increased blood flow Increased alertness Reduced sense of pain	Focused & selective attention increased Endogenous opiates released for analgesia
Autonomic Nervous	Increased sympathetic tone in the musculoskeletal, GI, metabolic, cardiorespiratory	Locus Coeruleus releases Norepinephrine with peripheral organ actions
Musculoskeletal	Increased blood flow	Dilation to the periphery
Gastrointestinal	Suppressed blood flow Increased gastric acids	Constriction of blood flow to the gut
Immune	Immediate enhancement Followed by a period of suppression	"Open window", leaving a person susceptible to infection as a subacute response
Metabolic	Mobilization of energy storage Sparing systemic processes with decreased blood flow to liver and kidneys	Exercise-specific responses* Gluconeogenesis Lipolysis Glucagon increases Insulin decreases Insulin sensitivity increases
Cardiovascular	Increased heart rate Increased ventricular contractility	Sympathetic drive through NE on the SA node
Respiratory	Increased respiratory rate Increased tidal volumes	Rapid improvement in oxygen-exchange efficiency and capacity
Reproductive & Growth	Suppression of both male and female substrate reproductive functions (energy storage, hormones) Reduced organ blood flow	Elevation of GH and Testosterone Can be exercise-specific and realize a subsequent drop
Thermoregulatory	Increase in core and peripheral body temperature Vasodilation in the periphery to dissipate heat build-up as a function of increased metabolic rate	Sympathetic-drive with microvascular regulation and activation of sweating response
Neuromodulatory	Release of endogenous Serotonin Release of endogenous Dopamine Release of endogenous opiates	Priming for new learning Elevated attention Increased tolerance for intensity Reduced pain receptivity Enhanced motivation Reduced depressive effects on brain (attention, expectations)

* Table 2 Physiology based solely on research with exercise as the intended stressor

Abbreviations: IS = Intentional Stressor NE = Norepinephrine
SA = Sinoatrial GH = Growth Hormone GI = Gastrointestinal
EBV = Epstein-Barr Virus HSV = Herpes Simplex Virus

Intentional Stressors: Beyond Intense Exercise

While one of the most common and available forms of intentional stress can be intense exercise, it is not the only pathway and should not be the only pathway that a person uses to introduce intentional stress. Exercise itself has many pathways. For the purposes and scope of this paper, suffice to say that exercise is just one form of physical activity with the specific intent to improve fitness. Exercise as an intentional stressor can come in the forms of endurance, weightlifting, and interval training. Practically speaking, one can achieve the same benefits outside of a gym, in their favorite physical activities of mowing a lawn, raking leaves, hiking, cycling, Tai Chi, swimming, walking, dancing or many forms of play – IF we are achieving high levels of exertion. Again, in an effort to be brief, we can over-generalize and be reductive, so I will carefully direct readers to the literature on this and summarize by saying that we benefit most by experiencing brief periods of breathlessness in whatever activity we choose. Those searching for a deeper-dive will appreciate that physical activity or exercise approaching VO2 max, lactate thresholds and resistance work "to failure" are largely going to be more well-supported in the literature for their effects on countering unintentional stress.

Exercise can be *largely* inexpensive and available, and physical activity (as listed above) can be even more engaging, inexpensive and available for some. While some individuals may be limited in their ability to access high levels of exertion due to other health conditions or even permanent disability (pain, weakness, loss of motor control). Note that in the section entitled, "Mechanisms of Action", the reader will see examples of the physiology proposed for both exercise and non-exercise opportunities (applications). To be clear, vigorous physical activity of all forms (exercise, volunteering, daily life (Vigorous Intermittent Lifestyle Physical Activity (VILPA)), may not be safely assumed to be superior to the non-exercise counterparts. As with most life systems, there are more than a singular pathway toward a desired outcome and there may be additional health benefits found in leveraging more than one pathway. All applications will we discussed in more detail, coupling with the mechanisms (physiologic pathways) in the next section.

An additional point of clarification is warranted. Readers may note that physical exertion that is *chosen* can be accepted as an intentional stressor. However, the very same physical exertion is not equally healthy (serving as an intentional stressor) when this exertion is legislated, regulated, coerced or used as retribution (Tang et al., 2022). Choice matters in exercise and all forms of physical activity. Two identical workouts or workdays may not be accepted in the same fashion across any or all of the body's systems or organs (brain, gastrointestinal, bone, immune or other) when there is an operative difference in choice (Tang et al., 2022), (Suzuki et al., 2002). This will be a recurring theme, one that is important to reiterate for each form of intentional stressor.

As noted in the introduction, some individuals are not engaged by the concept of exercise. Others may feel that exercise is a selfish pursuit or even a "waste" of energy that could be used for other productive purposes. We must acknowledge, accept and be able to adapt to cultural, generational, and societal differences as science affords. Fortunately, exercise is not the only option in the realm of physical activity (PA) that can serve as an intentional stressor. As alluded above, all forms of physical activity outside of exercise can serve as an intentional stressor, providing a person-first selection.

Each form of physical activity (endurance, resistance, recreational sport (agility)) will use a different pathway to benefit the individual (Law & Li, 2022; Fan, 2023; Wachsmuth et al., 2025). It is important to circle back to the resistance exercise musculoskeletal system briefly. Contrary to perceptions that persist and those that might be common from as recent as eight years ago, walking alone would not provide every opportunity for health. Our muscles and the tissues surrounding them (fascia) can be stimulated with load and prolonged stretch. Weight training toward our maximum capacities, as well as holding extended positions at the end of our comfortable range as in some Yoga poses and Tai Chi can also activate these mechanisms (Law & Li, 2022; Fan, 2023; Wachsmuth et al., 2025). Research continues, yet it is possible that deep tissue massage will eventually be identified as an opportunity to effectively stimulate the fascial network (vagal-adrenal axis) as well (Warneke et al., 2025; Liu et al., 2021).

An additional form of intentional stress that can be readily available and inexpensive is intermittent fasting. It is important at this point to reiterate that unintentional stressors can be the very same action yet not intended - or chosen - and can be both processed psychologically (to the detriment of mental health) as well as physically (systematically across other organs and systems - gastrointestinal, skin, muscle, heart, bone) to the detriment of the system. Practically speaking, we cannot and should not accept food scarcity as the same stimulus as a regularly scheduled, chosen practice of 16 hours without nourishment, and an 8-hour feeding window, otherwise known as a 16/8 intermittent fasting schedule.

As with many developments in the fields of lifespan and healthspan, there can be a pendular nature to both new and resurgent (popular again) information. Often, the latest fad that is touted to cure everything is fully debunked or insignificant just a handful of months later. The science on intermittent fasting (IF), time restricted feeding (TRF) and caloric restriction (CR) is no different. Readers are invited to perform a deeper dive on all of these approaches. Their place here, as an intentional stressor that may have a positive role in offsetting the effects of unintentional stressors is the emphasis - not their potential and debated benefits for weight loss, longevity, or healthspan. At a cellular level, the effects of intermittent fasting are neither fully understood by dosage or mechanism. To be concise, IF appears to reduce body-wide inflammation. This is healthy for all of us, as many of the most common and deadly diseases are connected through inflammation: diabetes, cardiovascular disease, cancer, autoimmune conditions, and more. For a peek at the deeper-dive, just note that a healthy microbiome (microorganisms thriving in our stomach and intestines) are

at the bottom of this, as they release anti-inflammatory agents known as short chain fatty acids (SCFAs) (Ríos-Covián et al., 2016), (Cadena-Ullauri et al., 2024).

Recently, thermal stressors at both extremes of hot and cold have experienced a resurgence in popularity. As with the pendulum-like comment above regarding the explosion of claims regarding strategies around feeding, the bio-hack and fad nature of thermal extremes has experienced wide popularity, followed by a period of waning. Sauna, hot tubs, contrast applications (cold-hot-cold), cold water swimming and ice plunges have gone from a "cure-all" to, "let us look at the science here a little more closely", most notably for cold exposure. The science of cold and heat should not be conflated. The mechanisms and benefits do not appear to be of the same pathways, despite some overlap.

When focusing on the intentional stressor benefits on thermals, the science for each extreme (hot and cold) is on much more stable ground than the claims presently being made in relation to longevity. Readers are directed toward the extensive literature on brown fat vs. white fat (Søberg et al., 2021), cold shock proteins and heat shock proteins (Alasady & Mendillo, 2024; Heinemann & Roske, 2021; Rauen et al., 2016) as well as exerkines (Feng et al., 2023).

There is emerging research to suggest two other forms of intentional stressors can be beneficial: diverse social experiences and novel or extreme experiences (Bergquist, 2025; Xia et al., 2025; James et al., 2023). Both of these pathways must be given a deep person-specific consideration for choice and dosage (volume, intensity, consequences). If you are going to challenge yourself with new experiences, extreme experiences, or counter your normal preferences of introversion…you do not need to endanger yourself physically or psychologically, "I don't feel safe", to benefit.

The intentional stressor of learning new concepts is related-to yet not the same as novel or extreme experiences. This body of knowledge (devoted to learning new concepts) is much deeper and more formidable than that of novel experiences. Lifelong learning – most notably when this includes new skills, new sectors of knowledge, a new language or even an instrument - can be a highly recommended activity for those seeking greater cognitive reserve (prevention by "filling up your tank") and cognitive performance (training and recovery). Novel or extreme experiences differ primarily from lifelong learning in the presence of risk or consequences – within safe parameters considering physical or psychological harm.

The Interaction Writ Large: How does intentional stress mitigate unintentional stress?

A quick glance at Table 1 and then over to Table 2 can give the casual reader the impression that there are very few differences in the body's response to US as compared to IS. While this is largely true, it is: 1) the interaction between IS and US; 2) the effects of chronic (consistent or persistent) exposure to each; 3) the total load of US and IS together; and 4) the ability to experience recovery (periodization and rest from each US and IS) that is at the core of this article. This is where health begins, where wellness takes off, and the Challenged Life Matrix begins to make practical sense.

At the proverbial 30,000-foot view we have "The 4 R's" model describing the benefits of intentional stress: resistance, repair, recycling and regeneration. Here again, we have an optional table that you can skip if this is too deep of a dive or enjoy if "this is your thing"!

Table 3 provides a summary of each, with references for readers interested in an even deeper-dive.

Table 3: The 4 R's of Intentional Stress (Bergquist, 2025)

4 R's Process	Application/Example	Description & References
Resistance	Resistance exercise or Intermittent Fasting - releasing anti-oxidants Exposure to thermal stressors Exposure to psychological stressors Hormetic exposure to bacteria	Oxidative (free radicals) and inflammatory stress Reinforced collagenous and skeletal matrices Creating immune system markers
Repair	Soluble & insoluble fiber - prebiotic	DNA, proteins, telomeres (protective end-caps on DNA) Microbiome Mitochondria Immune system
Recycling	Caloric restriction with sufficient protein	Natural waste processes to discharge aging cells: Autophagy
Regeneration	Liver, rehabilitation, autologous donation	Damaged tissues and energy systems

Chris Johnson, a well-known physical therapist with a long pedigree, an impeccable nationwide reputation, and a history of "therapist to the stars" (high performance athletes) expands on one of the four R's, resistance. Johnson, who could easily expand on the concept with a story about his own experience, being a high performing triathlete, is just too professional and too modest to do that. Instead, we hear Johnson relay this concept through the story of acclaimed rower Jordan Hanssen, author and subject of the book Rowing Into the Son (Hanssen, 2012). Is in a in a recent interview, Johnson offers a paraphrase

of his own personal communication with the Guiness Record holding rower, "...you know, nothing is more power than essentially being able to program stress that you have the say-in, because at some point a stressor is going to choose you that you don't have control over (Studer, 2025)" This is a real, powerful, and lived example of leveraging intentional stressors.

Mechanisms of Action: Intentional Stressors' Effects on Unintentional Stressors Experienced

How does the Challenged Life Matrix operate on a cellular level? This is tenuous and unstable ground to cover - yet that is a part of what makes it exciting to explore. What we truly know about the physiologic effects of IS on US is a combination of "known and unknown, unknowns". While it is exciting to hypothesize, it can be similarly dangerous and misleading to do so. As such, the reader can expect a cursory and conservative treatment to this topic.

Part of what IS can do to mitigate US can be found in the realms of mental health, expectations, the placebo effect, the nocebo effect, and largely the reward systems of the brain (Saunders et al., 2023). Goeleven and colleagues discuss this in their 2010 article on the positivity effect specifically as experienced in older adults (Goeleven et al., 2010). Geers and colleagues cover this in their 2013 article on choice and the placebo effect (Geers et al., 2013). Duckworth covers the same, pulling identity and positivity into her bestselling 2018 book, Grit (Duckworth, 2018).

Beliefs, choice, positivity, expectations, hope and reward. While there is a lot of overlap here, this paper will dissect or define the nuanced chemical pathways (neuromodulatory and neurohormonal) that separate these principles. While overly-simplified, suffice to say that our own internal beliefs (perception) and external forces (socio-cultural) will have an effect on any intervention, via the reward pathway (dopamine). What we believe (predict) and what we see (attention) are closely connected through complex reward systems ("feels best", is supported by our friends/family, "has worked for me in the past"). For a deeper-dive on this, the reader may use keywords including confirmation bias, placebo effect, and reward systems.

Related to personal preferences and beliefs, we see a surprising and dare say shocking inclusion of an internal stressor in the final row of Table 4 – scary movies. Author and psychologist Colton Scrivner explains the benefits in his October 2025 interview on the PBS News Hour. Scriver explains,

"In particular, I think playing with the emotions of fear and anxiety in safe contexts can be very useful for people. So, for example, if you go through life and you have shielded yourself entirely from feeling anxious and feeling afraid, when you become an adult, you are inevitably going to face some situations that elicit fear or elicit anxiety or both in your life.

And you may not be very well equipped to handle those emotions if you haven't experienced them before. In 2020, I did do a study with some colleagues, and what we found is that, when we control for demographics and general personality traits, we still find that people who were horror fans and people who scored higher in morbid curiosity were more likely to score better on measures of psychological resilience in those early months of the pandemic (PBS News Hour, 2025)."

There are many physiologic changes within body systems that occur outside of the central nervous system in response to chosen intentional stressors. A brief review of these are included in Table 4. The italicized words provide a deeper-dive.

Table 4: System-specific Responses to Intentional Stressors (Lazarczuk et al., 2022; Duffy et al., 2000-2013; Wang et al., 2020; Chen et al., 2010; Assas et al., 2016)

Body System	Intentional Stressor*	Mechanism of Action*
Muscles, tendons, bones (musculotendinous and musculoskeletal systems)	Resistance training *Fascial strain/deep tissue*	*Muscle hypertrophy, tendon reinforcement (Young's modulus), protein synthesis*
Vascular	Breathlessness in exercise or physical activity *Hypoxic stimulus in near-maximal aerobic training*	*Vascular Endothelial Growth Factor (VEG-F) stimulating the vascular proliferation (angiogenesis)*
Skeletal	Loading and impact in the forms of a rucksack, weight vest, barbell, machine or jumps *Plyometrics and resistance training to near-failure*	*Mechanostat detection signaling osteoblasts to activate*
Cardiorespiratory	Variety in endurance work, "can speak a full sentence" and "could not talk" *Aerobic training across a variety of zones*	*Left ventricular contractility*

Cognitive	Learning new information, instrument, language, being challenged to respond quickly in games *Novel stimuli*	*Diversity of connections within and between hemispheres* *Response speed* *Attentional resources*
Psychological	Horror movies Recitals/performances Public speaking Travel and moving to a new region *Pressure-based OR fear-based stimuli (time, potential for embarrassment, fear/to be scared)*	*Habituating sympathetic responses* *Conditioning (exposure therapy) to stimuli that has previously evoked (triggered) fear responses*
Gastrointestinal	Probiotics (live cultures) and prebiotics (fiber), intermittent fasting and spicy foods *Proliferation of the microbiome for SCFA release*	*Microbiome-mediated anti-inflammatory stimulation* *Capsaicin - stimulating the TRPV1 receptor leading to release of Substance P and calcitonin gene-related peptide (CGRP)***
Immune	Exposing ourselves to low levels of bacteria and fungi *The Hygiene Hypothesis*	*Immune system is exposed to bacteria, recognizes and strategizes for future exposure (T-cell mediated)*

*Both Intentional Stressors and Mechanisms of Action are consolidated and over-simplified for the purposes of this table and paper

**Readers are directed to the work of Assas et al., 2016 for a deeper-dive on the TRPV1 receptor. This is fascinating but highly technical reading (Assas et al., 2016).

The Trappings of Intentional Stressors: More (intensity, frequency, volume) = better, right?

Addictions of all kinds can be powerful. Most addictions have a basis in brain chemistry (neurohormonal or neuromodulatory). As the nature of an addiction suggests, it leads to dysfunction, interrupting normal life function. The extreme practice of intentional stressors can become addicting and can distract us from other life functions and pleasures. Intentional stressors can be abused to our own detriment (injury to our body, mind or social connections). We really do not know everything about the direct, lived experiences, yet should understand that we are both influenced by (social media, culture and our own social network) and we are influencing others (children and our friends) through our behaviors. Readers interested in a deeper-dive on the wide-ranging effects of our behavior should investigate epigenetics, informing us about how the workout tendencies, relationships to food, and health anxieties of a parent are passed down both genetically via DNA and by imprinting through observing.

Admittedly, our Western society has a ravenous appetite to consume "more". We want or consume more of everything that we perceive to be good, pleasurable, fun, or important. This attraction can extend beyond possessions and into activities intended for our own wellness. Yes, we can become addicted to intentional stressors. Most notably in Western cultures, "more" is perceived as better in food-for-price, supplements, physical activity, temperature of a thermal extreme, and distance of my event. The "more" approach is expansive to the point that there is even a "maximization of minimalism" - calorie restriction and minimalistic living. The extremes are celebrated, yet where is the dosage that is best for the body (hormesis)? How can we determine the best dosage of an intentional stressor? Can we determine the overall amount of good and bad stress that is accumulating in this person (allostatic load)?

Albeit overly simplistic, some of the most common injuries can also be a culmination of "too much of a good thing" in the form of an intentional stressor or pathway to higher performance. Examples include well-intended stressors/cumulative injuries that are an overdose of good intention include: caloric restriction for body composition leading to relative energy deficiency in sport (RED-S); overuse and bone stress injuries due to workload that is poorly managed; left ventricular hypertrophy over time in response to decades of high-end "red line"/near maximum aerobic performance (marathon, triathlon, and more).

Defining and Dosing Rest - to Recover from Both Subtypes of Stressors

What does rest look like to you? It is important to understand that just like every other element within the intentional stressors that we have discussed in this paper, choice matters. Preference matters. Rest is no different. So, if you took the opportunity to envision what rest looked like to you at the start of this paragraph You might have evoked images of your body quietly in motion in nature, sleeping comfortably in your bed, surrounded by trusted friends, or purposely positioned in either prayer or meditation.

Table 5 depicts some of the most common forms of rest that are adopted across the world. There is no order or ranking here, no judgement ascribed and no attempts to nudge a reader to adopt something new. Just options for you to consider, should they add value to you or to those that you serve. If you are in a space for the applications, just pay attention to the "Mode" column. If you are up for a deeper-dive, proceed!

Table 5: Rest, Recovery and Related Themes (Liu et al., 2021; Trupp et al., 2024; Aggarwal et al., 2023; Agorastos & Chrousos, 2022; Creswell & Goldberg, 2025; Sahu, 2021; Schor, 2025)

Mode of "Rest"	Suggested Mechanism(s) and notes
Programmed breathing	Overriding autonomic breath patterns with extended breath holds, prolonged exhales, and in some applications hyperventilation Cortisol Endogenous Vagal N. stimulation*
Quiet walk in nature	Awe – mechanisms speculated, remain unknown
Deep tissue massage	Fascial stretch stimulates vagal-adrenal anti-inflammatory axis and release of catecholamines
Play	Interhemispheric connection with competition, innovation Dopamine in novelty Reduced stress Improved resilience and adaptability Infinite games with no end, no winner, may hold particular superiority
Music (dance or perform)	May leverage the benefit of prior pleasures/experiences through episodic memories
Music (passively receive)	Innovation and interhemispheric connection
Interaction with or viewing art	Parasympathetic drive Reducing cortisol, slowing breathing rate, enhancing attention Painting, sculpture appear to have the greatest impact
Spirituality	Reduced incidence of depression, anxiety and increased self-efficacy Acts of prayer, faith may improve social connectedness and provide a sense of belonging/shared beliefs
Non-sleep Deep Rest, Yoga Nidra or meditation, napping	Neurotransmitter and neuromodulator effects on long-term cell resilience May include App-based meditation - guiding focus, thoughts, breathing Ritual practices of quiet mind, body

* Mechanisms of endogenous Vagus N. stimulation are a developing science. This table includes and refers-only to bottom-up and behavioral mechanisms, not an external or surgically-implanted stimulator (exogenous)

We return to Chris Johnson one more time for his insights on rest. Johnson works with some of the most well-known triathletes in the world and often with rising athletes that may not feel that they have time to rest. So, how does he program and define rest? Johnson offers, "I think that's an opportunity to lean in, engage the person and say, what are some of the activities that you find restorative? Maybe it turns out they like to watch a comedy, right? That's always something that I felt was helpful when I was in the crux of my training for long course racing. In general, I don't think of rest as something that's entirely passive though..." (Studer, 2025). In a society that respects freedoms and a developing body of science that is proving the value of beliefs and choice, it does appear that recovery from exercise-based intentional stressors should be:

- Defined by the individual
- Include some active participation
- Measured to determine effectiveness in this person

A Note for Healthcare and Wellness Providers

For therapists, physicians and healthcare providers reading this article, it is important to read the room, read the person. From a therapeutic alliance standpoint, we must do everything that we can to understand the big picture and the culmination of the various "eustressors and distressors" that this person is experiencing. A verbalized effort to, "get it right" can foster a healthy conversation and dialogue, a "leaning in" towards one another (patient and provider).

Each person is at a different breaking point in the totality that is their history, health and present life circumstance. This is the essence of the biopsychosocial model. Their relative allostatic load is a combination of physical, social and psychological pressures (stressors) that can only be indirectly measured and inferred. Two people that are the same age with the same injury or at the same point post operatively may have entirely

different capacities to tolerate intentional stressors within a programmed recovery plan.

Again, we revisit this topic within a recent interview with master clinician Chris Johnson. Johnson relays a subtle yet powerful strategy that he employs with his patients/athletes/clients, "...because I think when you put it on paper, you put it on a whiteboard, you're giving it life and you're also already starting to solve some of the challenges." Seeing salient issues addressed. Seeing problems listed, yet unresolved is often referred to as the Zeigarnik effect. While this phenomenon can be a powerful motivator, it can also improve the likelihood of dopamine being released, memories formed, and procrastination averted (Sahu, 2021).

Counterpoint: Why mitigate stress? Why not "just" avoid or cut-out unintentional stress?

Author James Clear writes, "Your success depends on the risks you take. Your survival depends on the risks you avoid." We are attracted-to and potentially fooled-by this notion that we can avoid stress or "cut it out" of our lives at will. Podcasts, articles, in-person advice and social media posts can be filled with advice about *eliminating* stress through many mechanisms. This article takes a different approach, one that attempts to provide practical strategies to reduce the effects of stress (mitigate), when avoidance is not possible.

As we conclude this article let us directly address the popular approach to stress management, "You need to reduce the stress in your life". Wouldn't it just be easier to eliminate significant contributors of stress in your life than to try to balance stress with other activities? After all these other activities in the forms of exercise, ice baths, intermittent fasting all come with a cost of time or inconvenience, right? In her book, "Four Days a Week, The Life-Changing Solution for Reducing Employee Stress, Improving Well-Being and Working Smarter", author Juliet Schor describes the research surrounding the effectiveness of reducing the work week to four days in 32 hours.62 Schor explores the benefits both to the worker, the employer, and in many industries to the third party receiving the product or service generated. Here we have an example of addition through subtraction. Is this an acceptable lesson for or analogy to the human body as well? Can we add quality of life (more days off of work per week) resulting in improved health by subtracting/eliminating the negatives (unintentional stressors experienced at work)? If this can be done in the workplace, can it be accomplished in our bodies?

Acknowledging that every person is different, every situation is unique, it is clear that our management of stress cannot be unidirectional - either mitigate or eliminate. Rather, the most successful approach would sensibly be multifactorial, multidirectional using a combination that feels best in his most appropriate to the person-context combination. We evolve over time and across our lives, hopefully becoming better versions of ourselves. The best solution that worked in our teens - using intentional stressors in the form of "going out for a run", may not seem practical if we may have less time in our 30s and 40s, yet may become the most viable solutions again in our 50s and 60s.

So, yes, it is important to both eliminate and mitigate stress. One final point is salient here. There are some secondary benefits to mitigating stress through intentional stressors that we need to count in the equation and our decisions. Readers will note that intentional stressors provide a counter to unintentional stressors yet also offer benefits through a very short and incomplete list of: muscular strength, cardiovascular fitness, mental resilience, microbiome and immune health. Purely eliminating stress cannot serve at all or equally as well across many of these capacities.

With the science stress (IS and US) as expressed in this article, perhaps we can rephrase the James Clear quote from above to read, "Your healthspan depends on the intentional stressors you take. Your lifespan depends on the unintentional stressors you avoid and counter (Clear, 2019)."

While the "goals" of any being were once thought to ONLY be, survival and reproduce…we have evolved. Now, quality of life matters. Healthspan is the new goal, one in which we strive to function independently, safely and consistently with resilience (Studer, 2024).

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