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Sparking Reframed

Letter from the Editor

Stuart Shanker DPhil

A paradigm revolution, like any revolution, needs an official organ: something to light a spark from which a fire will flare up. The political overtones of such a metaphor are by no means accidental. Thomas Samuel Kuhn chose it because he recognized how the war of ideas can sometimes be every bit as fierce as the battle for power. With one big difference. Paradigm revolutions aren't about one side trying to seize power from another. And they are certainly not about razing everything that stands to the ground. Paradigm revolutions, unlike paradigm shifts, seek to build on what has gone before, rather than ignore, or worse still, dismiss the accumulated wisdom of earlier ages. They seek to transcend polarized debates: to achieve a dialectical synthesis, not just of previously conflicting ideas, but amongst previously disparate fields of inquiry. The result is the construction of an interdisciplinary framework that supports a whole new way of thinking about some very old questions. And that requires a forum where these new ideas can be articulated, debated, elaborated, and deepened.

Revolutions of any kind occur when existing structures

and institutions are unable to cope with the proliferation of dysregulating forces. This is precisely the situation that we face today vis-à-vis the well-being of children, teens, and adults across the lifespan. The eruption of internalizing, externalizing, cognitive, and health issues is the unmistakable sign that existing attitudes and practices are unable to deal with current stresses, whatever these might be. The resulting paradigm revolution that is beginning to emerge represents a proactive response to conditions of mounting social, emotional, environmental, and technological challenges that we must not only adapt to, but also master if we are to thrive.

The metaphor for this paradigm revolution that jumps out at one here is Jean Piaget's notion of equilibration: that is, the idea that a growing set of demands, internal as well as external, force an organism to ascend to a new level of functioning if it is to flourish. Stresses are positive when they promote such a developmental leap, negative when they cause the individual to flee from or block out those stresses.

Piaget's concept also applies in a fundamental way to self-regulation: that is, to how the individual responds actively to new kinds and levels of stress, rather than passively submitting to them or trying to shut them out. The former response leads to growth in all its many guises, the latter to arrested development. This point clearly applies to the multiple problems that we are seeing in children, teens, and adults today, which are not nec-essarily the result of increasing stress levels, but are certainly

exacerbated by them. The fact that prevalence numbers continue to climb inexorably may tell us that we are getting better at tracking these problems, but clearly indicates that we are stalled in our efforts to reverse these trends.

Equilibration applies not just to development, but also, no less forcefully, to how we think about and respond to these problems. Just as attractors form as a way of blocking out or avoiding certain kinds of stressful experience, so too paradigm shifts represent a sort of "intellectual attractor" in which we swing from one polarity to another in what becomes an increasingly fruitless attempt to grapple with the spate of new problems that we are seeing. But equilibration of any sort requires a surge of energy to break out of an attractor, and that is where this new journal comes in.

Reframed: The Journal of Self-Reg seeks to capitalize on the excitement that Self-Reg has generated to stimulate the sort of massive effort required for a new paradigm to take shape and to take hold. The goal here is to understand why stress can be so positive in some situations and negative in others, and what we can do to combat the latter and promote the former. What is more, the journal seeks to tap in to the riches contained with-in existing research studies and theories, which may not have seemed to do so at the time, but which, viewed through the Self-Reg lens, significantly advance our understanding of stress and stress-reactivity: that is, contribute to, rather than conflict with the Self-Reg paradigm.

The emphasis in this new journal is on reframing as a means of fostering an ever-expanding movement. For it takes an army to sweep out the old order and install a new one, whether it's a paradigm or a form of government. This is why the metaphor of a revolution is so apposite: it is going to require as much a political as an intellectual effort to sweep aside the ancient self-control paradigm and embrace self-regulation in its place.

The self-control Old Order permeates every aspect of how we think about each stage of the life cycle: how we recognize and respond to stress-behaviours. Someone will eventually write the History of this Idea, which, only now, is becoming a distinct possibility; because only now is that history coming to an end (another allusion to Hegel!). The goal of this journal is to hasten that end.

The driving force behind any form of revolution is idealism mixed with overweening optimism. In the case of the Self-Reg-ulation Institute, what drives us is the vision of development as constrained rather than fixed: the push to learn as much as we possibly can about the factors that obstruct development and healthy functioning and how these can be overcome. This is the reason why Self-Reg needs an official organ: not just to serve as a forum for the expression of these new ideas, but also to be the spark that will inspire a vanguard of revolutionary thinkers and practitioners.

Stuart Shanker DPhil

Hide and Seek:

The Challenge of Understanding the Full Complexity of Stress and Stress-Reactivity

Stuart Shanker DPhil and Travis Francis HBASc

Abstract

This paper presents an *interactive* model of stress in place of more standard additive models. This approach considers not just the manner in which multiple stresses impinge on and magnify each other, but also the bi-directional relationship between internal state and stress-reactivity. Such an outlook has profound implications for our efforts to understand why so many children today are over-stressed.

Introduction

We are constantly being asked the same question by parents and educators: "What is the major stressor on children and teens today?" Is it urbanization? Too little exercise? Too little time spent in nature? Too much screen time? Overscheduling? Too little sleep? School? Social media? Smartphones? Junk food? The fact that we get asked the same question over and over speaks to the widespread anxiety that children and teens are over-stressed, and to an intuitive awareness that the above factors are significant stressors. But we could easily ask this same

question of ourselves, as no one seems immune in our over-stressed society.

What makes answering this question so difficult is that no two children – no two individuals – are the same. No two contexts are the same, and no one stays the same. What is a negative stress for one might be a positive stress for another, and what is a positive stress might easily turn negative (see "Good Stress Gone Bad," this volume).

We clearly need to deepen our understanding of the nature of stress if we are to understand when and why someone is hyper-aroused, and what to do about it. The problem is, stress is not just ubiquitous, it is necessary, and by no means intrinsically negative. We need stress to be motivated and animated: to function at our best and develop physically, psychologically, and emotionally. Too much stress, however, impairs motivation, functioning, and development.

Hans Selye's definition of stress continues to inform so much of our thinking on the subject "Stress is considered to be the physiological, psychological and biological reaction of the body to stimuli that requires one to consume energy in order to maintain homeostasis" (as cited in Viner, 1999 pp. 391 – 410). His point, which goes back to Cannon (1932), is that the brain responds to stress by triggering metabolic processes that keep homeostatic systems functioning within their optimal range. But there is not a single, unitary relationship between a given stress

and a biological reaction. The individual is responding to multiple stressors at any one time, with multiple homeostatic systems involved. So, the answer to the opening question, in regard to the major stressors today, is: “All of the above” – even in cases where one particular stress seems to stand out.

The deeper point here is that, in place of an *additive* model of stress, we are really dealing with an *interactive* phenomenon: not just in terms of the manner in which stresses impinge on and magnify each other, but also in terms of the bi-directional rela-tionship between internal physiological state and stress-reactivity. Whether a stress is positive or negative is as much a function of homeostatic balance as of the stresses themselves (Bernard, 1865/1957).

The fact is that there is an ongoing dance, as it were, between psychophysiological *state* and psychophysiological *reaction*. Accordingly, when we look at the above examples of major stressors, we need to consider:

1. Biological factors that strongly influence stress-reactivity;
2. The intensity/duration/persistence of the stressor;
3. The combined effect of the *totality of stressors;*
4. How internal state shapes the reaction to any particular stressor.

These four factors, together, underlie the variability that we see in stress-reactivity. One and the same stress can be energizing in a low energy/high tension state and damaging in a high

energy/high tension state. But the major factor in these different conditions is the overall stress load. Hence, to respond in a healthy, adaptive manner to a high-stressed environment such as exists today, we need to work on all five of the domains addressed in Self-Reg: biological, emotion, cognitive, social, and prosocial (Shanker, 2016).

An illuminating analogy here is how humans have responded to the stresses of outer space. Chris Hadfield's *An Astronaut's Guide to Life on Earth* (2013) provides a fascinating account of the ingenuity that has gone into enabling humans to survive in the most challenging of conditions. The combined effort of physiologists and physicians, working alongside engineers and astrophysicists, has made it possible to accommodate stresses that just a short time ago seemed insurmountable.

What NASA has accomplished in an astonishingly short period of time, evolution has done over eons, through the gradual process of natural selection. We have an exquisitely tailored nervous system for dealing with the stresses that predominated during most of this long evolutionary history; it is the effect of too many modern stressors, combined with lifestyle changes that override the Basic Rest-Activity Cycle (Kleitman, 1963), that shifts the stress pendulum from positive to negative, from anabolic to catabolic (Gluckman & Hanson, 2008).

The fact that a child or teen responds to a stressor in a negative fashion may tell us something about that stressor; it

may tell us something about that child or teen. In most cases, it tells us something about the child or teen's overall stress load. And the stressors involved go far beyond those listed at the outset of this paper.

Stress Inventories

Over the past 50 years, researchers have sought to develop a quantitative measurement of stress, looking at everything from major life events to daily hassles. In the late 1960s, Holmes and Rahe (1967) created the Social Readjustment Rating Scale, which assigns a value to various life events (for example, the death of a spouse is assigned a value of 100). These values are then added together to yield the total amount of stress that an individual is under.

> This scale, and others like it (Kranner, Coyne, Schaefer,

& Lazarus., 1981; Cohen, Kamarack, & Mermelstein, 1983), were developed to assess the relationship between stress and negative health outcomes. As valuable as these stress inventories are, they do not capture the interactive depth and complexity of the full gamut of stresses that we are witnessing today. As a step towards addressing this issue, we asked the students in the Shanker Self-Reg® Master Class Level 2 to identify stresses in each of the five domains of Self-Reg. The resulting list (see Appendix) represents the fruits of their labour and the power of the Self-Reg framework. This inventory presents various stressors of which, some are easy to identify and others that involve a deeper, closer

look. It is through the Self-Reg framework that these individuals have been trained to reframe their perspective on what a stressor is, as well as to recognize the signs and symptoms of stress.

Conclusion

We come back to our opening question of why so many children and teens today are over-stressed. In place of any sort of linear causal explanation, we need to look instead at the many differ-ent kinds of stresses that children and teens – and that we our-selves – are under, at the strain this imposes on an over-worked autonomic nervous system, and at the impact such a condition has on the capacity to cope with those positive stresses that, when the subject is properly restored, promote psychological and emotional growth. As is always the case with any seemingly intransigent problem, the first step towards a solution is under-standing the full complexity of what one is dealing with.

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Appendix

Shanker Self-Reg® Master Class Level 2:

Stress Inventory

This stress inventory was created with the contributions of the Shanker Self-Reg® Master Class Level 2 students.

Biological Domain: Self-Reg Stress Inventory	
Tooth pain	Equilibrioception (feeling “off balance”)
Allergies	Extreme weather conditions and excessive howling winds
Bright lights	Fluorescent lighting, lack of natural light
Busy traffic	Hard chairs
Caffeine	
Car/truck fumes	
Chapped lips	
Cigarette smoke or other pungent smells	
Too many things	
hanging on a classroom wall	
Deep or light touch	
Digestive disturbances or imbalances	
Food intolerance/sensitivities	
Eating sounds	
Eating sugar/candy	

Humming of power lines

Humming sounds from lights

Insomnia

Insufficient solitude and quiet

Listening and feeling of heart rate

Loud voices

Marathon training

Measuring for high blood pressure

Menstrual cycles

Noise of ATVs in one's backyard

Non-restorative sleep or sleep disturbed

Online courses (increased screen time)

Perimenopause/menopause

School buzzers

Scratchy tags or seams on clothing

Sensation of one ear being plugged

Smells

Stinging eyes

Stomach cramps

Strong "city" smells

Strong tastes

Biological Domain: Self-Reg Stress Inventory

Having cold hands and feet in winter

Having to sit too long in meetings and sessions

Hormonal changes

Tapping fingernails

Thermoception

Texture of food

Unhealthy eating

Emotion Domain: Self-Reg Stress Inventory

Asking someone with scents/ fragrances to go scent-free

Explaining something to someone and they don't understand

Being in any kind of deep relationship and experiencing the strong emotions involved, positive and negative

Board members or staff reneging on promises and responsibilities

Children fighting — lack of control in a distressing situation

Comparing self to others

Confrontation

Depression

Disagreements/arguments

Disappointment

Divorce

Doubtfulness

Family member is ill	Over-excitement
Fear of things like heights	Paranoia
Feeling pain	Preholiday (e.g., Christmas) build-up
Feeling unwelcome	Public speaking
Foster care	Strong emotional expressions
Intense surprises	Unresolved emotional conflicts
Leaving parents to go into school	Waiting in line
Grief/loss	

Cognitive Domain: Self-Reg Stress Inventory

Four-way stops	Decoding
Being last to grasp new concepts	Difficult tasks or tasks that are not age-appropriate
Competition	Feelings of inadequacy
Confusion (not detecting meaning or patterns)	Forgetting a shopping list
Constant new learning (e.g., report cards)	Having a to-do list in one's head, not written down

Cognitive Domain: Self-Reg Stress Inventory	
History/past experience	Remembering information
Information overload	School improvement
Information presented too quickly	Skewed perception
or too slowly	Slow processing in a speedy world
Lack of intellectual stimulation	Time pressures
Learning a new language	Too many steps
Making decisions	Trouble recognizing patterns and
Memory lapses	symbols
Multitasking	Unable to retain mathematical
New information that doesn't fit in	information
to what one currently "knows"	Unable to track along with the
Not given opportunities to speak	written words on a page
and contribute	Being uninterested in a topic
Not understanding material for a	Walking into a room to get
course, reading the same passage five times	something and then not being able to remember what it was you came
Poor working memory	in the room to get
Reading challenges	

Social Domain: Self-Reg Stress Inventory	
Being in a social setting alone	Disagreements with one's partner
Being a victim of bullying	Eating slowly in a fast-eating world
Big groups	Engaging in small talk and not
Confrontation	really connecting at a meaningful level
Confusing social situations	Events: funerals, weddings, baby
Constant social input when one has	showers, etc.
an urge to be alone	Exclusion
Crowds	Fake social niceties between people
Defensive reaction in self when	Fashion
one disagrees with what someone	
is saying	Feeling unappreciated

	Feeling you have to socialize with a group of people you don’t know

Social Domain: Self-Reg Stress Inventory

Getting a turn in conversations

Going somewhere new

Hostility

Informing someone their chosen fragrance is a scent in a scent-free environment

Intense one-on-one interaction

Internet dating

Interpersonal conflicts

Jealousy

Joining a table of strangers and having to introduce yourself

Lack of friends

Large family gatherings

Meetings where people engage in side bar conversations

Moving crowds

Obvious socially inappropriate comments

Planning details of a wedding

Presenting a good first impression when meeting someone new

Public speaking

Putting on a social face when you are feeling a little too tired to entertain

Reading social cues

Small talk at social events (e.g. birthday parties, holiday events, showers, etc.)

Two or more people talking at the same time

Walking into a social or professional function alone and not seeing anyone you recognize or know

Prosocial Domain: Self-Reg Stress Inventory

“Ignoring” a panhandler while waiting in left-turn lane	Feeling the stress of your own children and other family members, especially in the midst of a dysregulated moment
A sick child	Feeling unprepared
An obsessive need to follow the news	Guilt
Being exploited by people, organisations, and/or politicians	Having a huge circle of friends and colleagues, many of whom seem to be having a crisis
Being late	Injustice
Dealing with others’ strong emotions	Interacting with individuals or groups that don’t really “get you” or even care to know you, or that are quick to assume things about you
Feeling intensely as you listen and empathize while someone is sharing, being exhausted after supporting someone through a very emotional intense event	

Prosocial Domain: Self-Reg Stress Inventory

Internet dating	New neighbourhood Other people's discomfort
Lack of community resources	Punitive rather than restorative justice
Lack of empathy due to compassion fatigue	Putting needs of others before one's own
Lack of gathering places	Unfairness
Mind reading resulting in trying to please everyone or feeling overwhelmed	When one's partner is stressed
One's children's distress, and not being able to solve their problems for them	Working in the helping professions and feeling all the feels of clients one supports

Good Stress Gone Bad:

Transition Conditions in Transforming Stress from Negative to Positive

Stuart Shanker DPhil and Elizabeth Shepherd MSc

Abstract

One of the basic precepts of Self-Reg® is that one's level of energy and tension is critical for whether a particular stressor is experienced as positive or negative. This energy/tension state is largely a function of one's overall stress load. Accordingly, the better we can manage our stress across five domains – bio-logical, emotion, cognitive, social and prosocial – the better we can maximize positive arousal and performance.

Ever since Yerkes and Dodson (1908) published their "law" that performance improves with arousal but then deteriorates past a midpoint if arousal continues to increase, psychologists have sought to understand how we can manage arousal so as to maximize performance. The issue here is stress: How much is beneficial? When and why does it become detrimental? Can we transform negative into positive stress, and for that matter, prevent positive stress from turning negative? Is negative stress *inherently, irrevocably* negative? These are questions that lie at the very heart of Self-Reg.

Scan through the literature on stress and you find one group extolling its benefits (see, for example, McGonigal, 2015; Abbott, 2016) and another warning of its harmful effects (see, for example, Benson, 1975; Maté, 2004). This distinction was first made by Selye (1956, 1976) when he differentiated between eustress and distress. Eustress is physically as well as psycho-logically and emotionally beneficial (Sapolsky, 2014, 2015), while distress is potentially damaging to the body as well as the mind (Sternberg, 2001; Beauregard, 2004; Seligman, 2012; Fogel, 2013).

The problem is, one and the same stressor can lead to eustress for one individual and distress for another. Or, what has hitherto been a positive stressor can become negative (think of over-training). And one and the same stressor can be positive on one occasion and negative on another, or sometimes both – si-multaneously!

The predominant approach to dealing with this compli-cated issue has been cognitive: that is, following the idea that how a stressor is perceived determines whether it is experi-enced as positive or negative (Everly & Lating, 2012; Solomon, Smith, Robins, & Fischbach, 1987). The emphasis has been on reappraisal (Cognitive Behavioral Therapy) or non-appraisal (non-judgmental mindfulness [see Kabat-Zinn, 1990]). Both strategies have been shown to be effective. But more is needed.

Your physiological reaction to a stimulus often determines how you perceive it. Someone with a heightened sensitivity to noise might find a cocktail party overwhelming, while someone with a low sensory threshold finds the same experience invigorating. What is more, reappraisal or non-appraisal do not help those who, for example, are sent into fight-or-flight by repetitive low-frequency sounds (Willis & Malcolm, 2016). But what is especially significant about conditions like misophonia, or the effect of heightened anxiety in general, is the impact of energy and tension on sensory reactivity.

In other words, where one sits on the Thayer matrix (see Figure 1) is central to the discussion of "transition conditions."

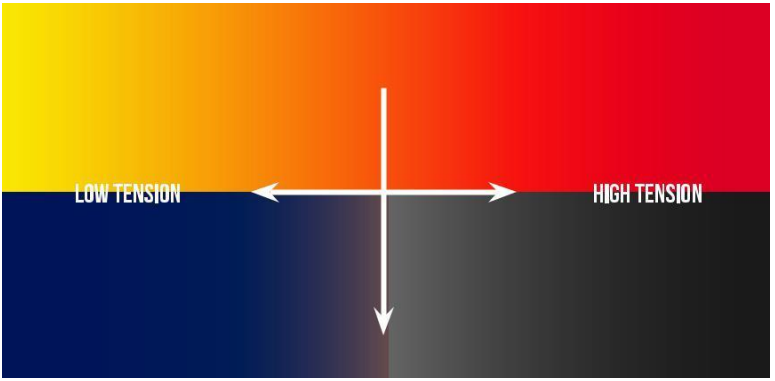

Figure 1 – Adapted by The MEHRIT Centre from Robert E. Thayer (1996) *The Origin of Every Day Moods: Managing Energy, Tension, and Stress,* this matrix depicts various energy and tension states.

Not only does the state one is in profoundly influence how a stimulus is experienced, but the reverse is also true: that

is, the stimuli you are subjected to profoundly influences the state you are in. One and the same stress can be experienced as positive if you are in a high energy/low tension state (HE/LT) and negative if you are in a low energy/high tension state (LE/HT). Hence it follows that the better one can identify and reduce the stressors that lead to LE/HT, the better one can manage how a particular stress is experienced.

The big complication in all this is that to exercise these self-regulation skills involves not just physical or emotional stress, but also cognitive, social, and prosocial stress (Shanker, 2016). These multiple stresses are inextricably bound together, constantly impinging on and intensifying one another. Hence the Yerkes-Dodson Law (see Figure 2) is a function of all five of the major stress domains addressed in Self-Reg.

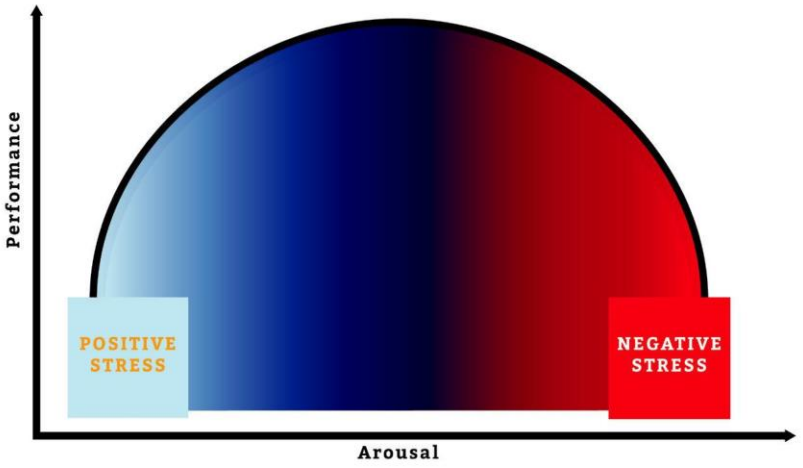

Figure 2 – A conceptualization of the inverted-U, identifying the transition of positive stress to negative stress along arousal. Peak performance is achieved when energy depletion and recovery is balanced.

In Daniel Goleman's (2012) terms, the far left side of the curve represents "disengagement," the far right side represents "frazzle," and the midpoint represents "flow." Flow denotes a balance between energy expenditure and recovery (sympathetic and parasympathetic processes). Too much stress leads to an excessive buildup of dopamine and cortisol (Csíkszentmihályi, 1990; Landhäußer & Keller, 2012), which in turn triggers *limbic braking:* the reason why performance declines markedly (Shanker, 2017).

What this means is that managing transition conditions has to be looked at through a holistic lens. That is, we need to identify the major stressors that are contributing to a state of hyper-arousal. Any particular stress that stands out needs to be understood within the complex of stresses the individual is dealing with (see "Hide and Seek," this volume). To transform negative into positive stress, or prevent the reverse, one needs to look at all five domains of stress, identifying both hidden and overt stressors, as well as the interactional effect of stressors on one another (Shanker, 2016).

The development of stress-awareness is especially important. All too often, we only become aware that something is a negative stress when we have gone well past the midpoint of the arousal curve. But rather than trying to suppress or inoculate a negative stress, Self-Reg teaches us to view our response to a negative stressor as an invaluable signal as to where we sit on the arousal curve. And that in itself is a key to transforming

negative stress into positive. By asking ourselves those perennial Self-Reg questions, “Why?” and “Why now?,” we can reframe a negative stressor. Even a seriously negative stress can be made positive provided we grasp what it is telling us.

In other words, from a Self-Reg perspective, the “transition conditions” that are such a pivotal aspect of self-regulation are as much a function of what we know as what we see and do. Or rather, what we know shapes what we see and do (see “Reframing,” this volume).

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Self-Reg and Reframing

Stuart Shanker DPhil and Casey Burgess MA

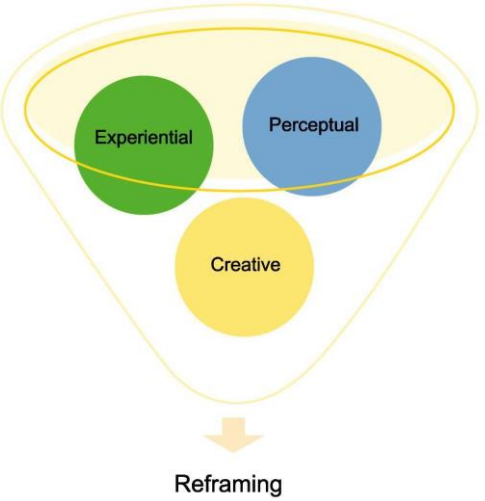
Abstract

Shanker Self-Reg® always begins with *reframing*. The concept of reframing is grounded in the work of Ludwig Wittgenstein. Reframing constitutes an "aspect-shift" in how we see and categorize the world around us. Perceptual, experiential and creative components are all involved. The current paper explores each of these strands and how they are woven together. It then discusses how reframing applies, not only to behaviour, thought and emotion, but even to scientific research and theories.

Reframing

Shanker Self-Reg® always begins with reframing. See a child as misbehaving and you are likely to respond in a harsh, even punitive manner. See the same child as exhibiting stress behaviour and you respond by helping that child to self-regulate. What is at stake here is not a different method of "managing a child's behaviour." The lesson here is rather: "See a child differently and you see a different child."

There are three essential components involved in reframing: perceptual, experiential, and creative. By digging into existing research about reframing, our goal here is not only to understand each of these strands, but also to see how they are woven together.



My thinking about reframing was originally inspired by what Wittgenstein says about "aspect-shifts." See a philosophical question differently, he argues, and you arrive at a whole new type of answer. Wittgenstein summed up what he had in mind here when he told Con Drury that he was thinking of using a quo-tation from King Lear, "I'll teach you differences," as the motto for Philosophical Investigations. This line captures the essence of Wittgenstein's contribution to philosophy: the distinctions that he draws, for example, between science and philosophy, or between grammatical and empirical propositions, or between first-person and third-person psychological utterances. The reason why this sort

of philosophical investigation is so important is because of the metaphysical confusions that result from failing to clarify

these often very subtle logical distinctions (see Hacker 1972).

We could easily use the same quotation, "I'll teach you differences," as a motto for Self-Reg. Here too we are concerned with vitally important differences: for example, between self-control and self-regulation; misbehaviour and stress behaviour; oppositional defiance and fight-or-flight; compliance and freeze; lying and confabulation; not listening and not processing; lack of effort and limbic braking. However, in this case what is at stake is not resolving some metaphysical confusion, but the well-being of children and teens.

The idea behind reframing in this psychological context is that when, for example, you look at a child's behaviour through a self-control lens you may see opposition, but look at it through a Self-Reg lens and what you see is fight-or-flight. Yet reframing is not some sort of "optometrical" phenomenon: the result of changing from the green-tinted glasses of self-control to the rose-tinted glasses of Self-Reg. The perceptual shift operating here involves a fundamental shift in categorization (Goldstone, 1994).

This is an idea that goes all the way back to Plato: specifically, his idea that we see the world through concepts, which we acquire – implicitly – when we learn how to speak (Baker

& Hacker, 1980). We see what our parents teach us to see: our culture shapes what we perceive. When one sees a cow one might see a sacred creature; a demon; a food source; a dumb brute; a sentient creature that thinks and feels pain.

Perceptual Reframing

Each of these "ways of seeing" is embedded in a network of concepts (Goffman, 1974). When we reframe something, we are consciously shifting from one framework to another, and an essential aspect of the reframing is learning how to map the new conceptual terrain (Berger, 2008). For example, misbehaviour is internally related to the cluster of concepts that apply to purposeful actions: intentionality, choice, explanation, justifica-tion, responsibility. It is because of these conceptual links that we automatically think of punishment as a way of responding to misbehaviour. But stress behaviour belongs to the category of non-purposeful behaviour: that is, behaviours that are caused by sub-cortical processes. Stress behaviour is tied to arousal, tension, energy depletion, neurohormones, and in general, limbic process-es. Hence our automatic reaction to stress behaviour is to under-stand and down-regulate.

Experiential Reframing

When we reframe, we are not simply looking at the same thing through a different lens. What we see is completely differ-ent, and we begin to understand what this is by exploring the new conceptual links. But, whereas for philosophy reframing is essen-tially a logical exercise, for Self-Reg reframing involves an experi-ential shift that is every bit as powerful as the cognitive. It is not just what we see that is so different, but, essential to this process, what we feel.

These two aspects of reframing – perceptual and experiential – are bound up with one another. The more we can tease apart the conceptual links in the new framework, the more profound-ly our emotional response to a child or teen is affected. But what changes most of all is what we start to ask. For reframing not only involves a new way of answering old and established questions, but also raises entirely new ones and leads us in direc-tions that were not, and likely could not have been discerned in the old framework.

Creative Reframing

The third essential aspect of Self-Reg reframing is that it sparks off creative new ways of thinking: about children and teens, about ourselves, about theories and experimental paradigms. In this sense, reframing is like a closure impossibility proof in mathematics (Shanker, 1988): it closes off one line of thinking (for example, self-control) while opening up a completely new one (self-regulation). This is the reason why Gödel's theorem was so important for mathematicians and why Self-Reg is so important for parents and educators. We truly do not know where a reframing is going to lead: only that this is a path that we must follow.

Conclusion

Following the path of reframing the existing scientific literature about stress and stress management will be a key element in Self-Reg research. Through re-perceiving and re-experiencing rigorous research, and finding creative ways of thinking about how this research touches current challenges, we can take our understanding of stress and Self-Reg in hitherto unseen directions with productive results for all.

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Reframing:

A Literature Review

Casey Burgess MA

Dr. Shanker's paper (this volume) examines the con-cept of reframing – the idea that there are multiple meanings of everything that may be perceived. Goffman's Frame Analysis (1974) explains reframing as an examination of the terms of the organization of experience. While frames can help us to under-stand other perspectives, difficulties with framing can arise due to ambiguity or framing errors caused by engaging in inaccurate premises without trying to determine what is really going on. Often, among scientific disciplines, a lack of communication can occur when one field accepts a hypothesis and another discredits it (Entman, 1993), leaving in its wake a need for cross-disciplinary research to push understanding forward.

Reframing has often been seen in scientific literature, leading to new research-grounded ways of using existing knowl-edge for advancement in various fields. Reframing is evident, for instance, in the following: a shift to a heliocentric view of the universe (Weinert, 2014); a shift to seeing one thing in two ways (Berger, 1972); a shift in the narrative of battered wom-en from decline to growth (Arnold & Ake, 2013); a shift from

segregation to mainstreaming to inclusion (Terzi, 2014); and a shift from division and scripted understanding to unscripted truth and reconciliation (Tovares, 2016). Hundreds of articles can be found explaining how a new frame for a problem can lead to new approaches and interventions in risky behaviour (Lustig

& Sung, 2013; Pingel, Bauermeister, Johns, Eisenberg, & Leslie-Santana, 2013), domestic violence (Arnold & Ake, 2013; Behr, Grit, Bal, & Robben, 2015), leadership (Murray & Clark, 2013; Raelin, 2016), education (Masocha, 2015; Winstone & Millward, 2012), and developmental disabilities (Grinker, 2015; Lester & Paulus, 2014).

Historically, self-regulation itself has been framed in a variety of ways, from being seen as behaviour-based and involving compliance and will prior to the 1950s to being seen in the light of emergent and contemporary research (1950-1990), which be-came focused on cognition and its implications to development (Post, Boyer, & Brett, 2006). Expansionist research, from 1990 to the present, shows self-regulation to be linked to every category of psychology with a wide range of contexts and directions (Post et al., 2006). With 447 different uses of the term self-regulation in the literature (Burman, Green, & Shanker, 2015), a consistent framework grounded in rigorous science is needed to approach society's growing problems, such as increases in physical health issues like obesity and autoimmune diseases, internalizing and externalizing problems, risky behaviour, and poor education outcomes ("People For Education 2010 Keynote Address, " 2010).

The Shanker Self-Reg® framework (Shanker, 2012, 2016) provides a reframing of existing behaviour-based mod-els of child and adult well-being by looking at known develop-mental trajectories with a neuropsychological lens and defining self-regulation as the body's ability to respond to and recover from stressors. Reframing human development and well-being in this manner opens the door to a potential shift in responses and interventions for child development, both typical and exceptional.

Research on the process of reframing is very limited, but does center around the art of thinking differently, based on Kuhn's ideas of paradigm revolution: trying to determine why we do the things we do, and how we might do them differently (Benammar, 2012). Little research goes into any detail on re-framing beyond this work. Future research is warranted on the process by which we can look at existing knowledge with a new lens, in order to expand on its application within developmental psychology and child intervention.

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Masking Stress with Misbehaviour:

A Shanker Self-Reg® Lens

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Abstract

The concept of self-regulation has been present in the literature for over 150 years. However, many believe that self-regulation and self-control are synonymous. According to Shanker Self-Reg®, self-regulation makes self-control possible by understanding stress and effectively managing our energy and tension levels. This paper discusses and provides evidence in support of the key constructs of Shanker Self-Reg®, including the 5 Steps of The Shanker Method® (reframe, recognize, reduce, reflect, and respond), the distinction between stress behaviour and misbehaviour, the importance of reframing what is often viewed as misbehaviour as stress behaviour, and much more.

An adolescent tells her mother she doesn't care about school and storms out of the room, slamming the door behind her.

A student in Grade 4 punches another student in the playground for no apparent reason. This happens often.

A college student procrastinates on completing a final paper for a course and after multiple chances to submit the paper late just gives up and fails the course.

A three-year-old has a tantrum at the department store when her dad says no to buying the toy she wants him to buy.

A teacher loses her temper and yells at her students after telling them for the third time to work quietly.

A bus driver humiliates a senior citizen when she puts the wrong amount of money in for the bus trip because she

didn't know the cost of the fare had gone up.

Stuart Shanker contends that when we see a person *differently*, we see a *different person* (Shanker, 2016). Any of the examples of misbehaviour listed above can be reframed as *stress behaviour*, thereby deepening understanding of the roots of the behaviour and opening up new ways of responding. Shanker Self-Reg® is a five-step method for managing stress, which involves recognizing the signs of stress behaviour; identifying and reducing negative stresses; becoming aware of the signs of escalating stress; and developing customized strategies for returning to a state of being calmly focused and alert (Shanker, 2016). The dif-ference between self-regulation and self-control,

misbehaviour and stress behaviour, and the five steps of Shanker Self-Reg® are discussed in this paper.

Untangling Self-Regulation from Self-Control

Burman, Green, and Shanker (2015) documented 447 different uses of the term "self-regulation" in the psychological literature. The multiple uses of "self-regulation" were categorized into six concept-clusters: self-control, including emotional regulation and control; self-monitoring; self-management; social behavior; agency or self-determination; and self-regulated learning. According to Shanker, *self-control* serves as the overarching construct linking these six clusters of self-regulation definitions. It is important to note that self-control and self-regulation are not synonymous in Shanker Self-Reg®, which focuses on self-reg-ulation. Self-regulation from the psychophysiological lens is what makes self-control possible.

Self-control became a focus in psychological research largely due to the "delay of gratification" studies that began to appear in the late 1960s (Mischel, 2014; Mischel, Ebbesen, & Raskoff Zeiss, 1972). These studies showed that problems in self-control could be detected in children as young as four, and that these problems were associated with challenges in emo-tion-regulation and executive functions (Eisenberg et al., 1995; Blair & Razza, 2007; Diamond & Lee, 2011). The self-control paradigm became dominant because of the longitudinal studies showing that the children identified at a young age as having poor self-control fared worse over the long run, both physically and academically, and had significantly higher rates of internalizing and externalizing disorders as young adults (Moffitt et al. 2011;

Mischel, Shoda, & Rodriguez, 1989). This research led many to conclude that children should be taught in primary school how to control their impulses (Schlam, Wilson, Shoda, Mischel, & Ayduk, 2013; Diamond, Barnett, Thomas, & Munro, 2007).

The Psychophysiological Definition of Self-Regulation

In 1865, the father of modern physiology, Claude Bernard, inaugurated the scientific study of what came to be known as "self-regulation." Bernard was interested in the mechanisms that enabled an organism to maintain a stable internal state in response to both internal and external "perturbations," what Walter Bradford Cannon (1932) later defined as "stressors." In its original psy-chophysiological sense, *self-regulation* refers to the way one re-covers from the expenditure of energy required to deal with stressors.

In psychophysiology terms, self-regulation is a prerequisite for exercising self-control. An unstable internal state can lead to a limbic response – fight-or-flight, or freeze (a primitive neural response to threat easily misconstrued as compliance) – and impinge on the functioning of the prefrontal cortex, the part of the brain governing self-control (Porges, 2011; McEwen, 2007). The more an individual is chronically hypo- or hyper-aroused because of excessive stress, the more readily that person goes into fight-or-flight, or freeze (Lillas & Turnbull, 2008). These fight, flight, and freeze limbic states suppress, and at times "brake," the necessary mechanisms in the prefrontal cortex for the practice of self-control.

The psychophysiological definition of self-regulation on which Shanker Self-Reg® is based refers to how effectively we manage stress. When one is *over-stressed*, tension increases markedly and energy reserves drop sharply. In what Shanker describes as a “red brain” state, limbic arousal is heightened, fight-or-flight responses are easily triggered, and the “blue brain” (prefrontal cor-tex) functions critical for learning and well-being are suppressed.

The Five Steps of Shanker Self-Reg®

Grounded in the psychophysiological science of self-regulation (Fogel, 2013; Greenspan & Shanker, 2006; McEwan, 2007; Porges, 2001, 2011) combined with a Dynamic Systems Theory lens (Fogel, King, & Shanker, 2007), Shanker Self-Reg® is a meth-od for understanding and managing stress. Self-Reg was first described in detail by Shanker in *Calm, Alert & Learning: Strategies for the K–6 Classroom* (2012). In Shanker's most recent writings (2016), this five-step process, practiced as part of everyday life, enhances self-regulation in children, youth, and adults:

1. read the signs and "reframe" the behaviour;
2. recognize the stressors across all five domains of experience

   – biological, emotion, cognitive, social, and prosocial;
3. reduce the stressors and lighten the stress load;
4. reflect – enhance stress awareness by becoming aware of what it feels like to be calm and when you're in fight-or-flight or freeze;
5. respond – develop personalized strategies to reduce tension and restore energy by figuring out what brings you back to being calm.

Reflect on the scenarios in the introduction to this article

– an angry adolescent, an aggressive Grade 4 student, a procrastinating college student, a child having a tantrum, a teacher who loses their temper, and a bus driver who takes his frustration out on

a senior citizen. As we reframe with Shanker Self-Reg® we ask ourselves reflectively: “why this person” and “why now?”

How might their behaviour be derived from the accumulation

of stressors they are experiencing? Here are two examples of seeing a person differently – through the lens of Shanker Self-Reg® – to recognize that what appears to be misbehaviour may in fact be stress behaviour:

Instead of seeing a yelling teacher, see a teacher who has been struggling with spring allergies for weeks, is worried about her ailing father's health, has a teenage daughter who has told her she hates her three times this week, and spent lunch hour once again supporting her colleague who was in tears feeling overwhelmed with the many needs in her classroom this year that she can't seem to meet. You will see a teacher with an excessive stress load, the signs of which leaked out through yelling in frustration, not so unlike the adolescent with the limbic utterance: "I don't care," when she really does, quite deeply.

Instead of seeing an abusive bus driver, see a bus driver who has been struggling with horrible traffic all day, and has spent too many hours without moving, maybe without eating, and you see, not an ogre, but someone whose needs in that moment are not that different from the three-year-old in the department store. A gentle word to him, and to the flustered senior citizen, might just be all that is needed to help them connect with each other in a way that is good for both of them.

Shanker's work emphasizes that enhancing one's self-regulation requires learning to understand and manage

stress through an ongoing iterative and developmental process. In other words, Self-Reg is about stress and the connected energy and tension states beneath the problematic behaviours, not the

behaviours themselves. Misbehaviour is a mask, it is what is visible on the surface. Using Shanker Self-Reg® we can gently begin to peer behind the mask to better understand the excessive stress that lies beneath the outward "misbehaviour." Seeing people differently with science-informed "soft eyes" brings with it the most amazing shift: we truly do, as Shanker says, see a different person every time.

Table 1 identifies and defines many of the key concepts of the Shanker Self-Reg® Framework. This table additionally includes research describing the origins of and supporting the inclusion of these constructs.

Table 1: Key Definitions and Research Underpinning the Shanker Self-Reg® Framework
Stressor
A stressor is anything that disrupts homeostasis, and requires the organism to burn energy to return to homeostatic balance (Cannon, 1932).
Selye's research (1956, 1976) helped make the term "stress" more common.
The HPA Pathway
The HPA Pathway – hypothalamus, pituitary gland, and adrenal glands – is mobilized in the stress response to prepare the body for fight-or-flight, or freeze (McCain, Mustard, & Shanker, 2007; Porges, 2011).
Porges' research introduced a new paradigm in human development be-cause of the effects of allostatic overload – the consequence of prolonged and excessive stress – on the systems in the prefrontal cortex that subserve such "higher" functions as language, social cognition, executive functions, and self-control (see van der Kolk's Foreword to Porges, 2011).
Porges (2001) identified a "hierarchy" of four neural mechanisms for deal-ing with stress: (1) social engagement; (2) fight-or-flight (sympathetic arousal); (3) freeze (parasympathetic arousal); and (4) dissociation. This hierarchy represents an application of MacLean's (1990) "triune" model of the brain, from the "newest" to the most ancient mechanism.
Secondary Altriciality

Secondary altriciality is a term, coined by Portmann (1941), that refers to human newborns' need for nourishment from their caregivers, due to their physical, neurological, and behavioural vulnerabilities.

The term was rediscovered by Gould (1976), who stated that human infants are born premature and require their environment to finish developing.

Human neonates are born prematurely, with brains less than 30% of their adult size (Dunsworth, Warrener, Deacon, Ellison, & Pontzer, 2012). The consequence of this is that human newborns are utterly helpless and therefore are highly dependent on their caregivers for support. However, this vulnerability opens babies' brains to an extraordinary ability for post-natal plas-ticity, enabling children to become highly attuned to the environment they are born into and adapt to it accordingly.

Greenough, Black, and Wallace (1987) found that enriched environments promote brain development, specifically dendritic density; however, these results were later seen as research into the effects of deprivation (a stressor), rather than enrichment, because in a natural (non-laboratory based) environment enrichment naturally occurs.

The Interbrain

The interbrain refers to the connection between a higher and lower order brain, allowing caregiver and infant to change each other's arousal states (Dumas, Nadel, Soussignan, Martinerie, & Garnero, 2010).

Since newborns' brains are premature (see Secondary Altriciality) and executive functions within them have not yet formed, the baby requires a higher order adult brain to serve as an "external brain" to regulate the baby's physiological states. The higher order brain reads the baby's cues – such as facial expressions, posture, movements, and sounds – and adjusts actions accordingly either to up-regulate (stimulating) or to down-regulate (regulating) the baby as necessary. These dyadic experiences are vital to help the baby to develop the capacity for self-regulation, emotions, the HPA axis (our central stress response system), perceptual skills, cognitive skills, and communicative skills.

Dynamic Systems Theory (DST)

Stressors across the five domains of Self-Reg – biological, emotion, cognitive, social, and prosocial – are viewed through a dynamic systems theory lens, as interacting and co-actional.

Tim Van Gelder (1998) states that systems are sets of interdependent variables. A variable is a single unit, subject to change. Interdependent variables are those that change dependent on others, and that are in turn depended upon by other variables.

BIOLOGICAL DOMAIN

Self-regulation is, in part, a function of becoming aware of one's arousal states to bring oneself back to a state of being calmly focused and alert (Burman, Green, & Shanker, 2015).

Brazelton (1961) and Brazelton and Nugent (1995) considered six arous-al states – asleep, drowsy, hypo-aroused, calmly focused and alert, hy-per-aroused, and tantrum – but focused on awareness, activity (physical or mental), energy (how much is being burned), and tension (high/low).

McEwen (1998, 2007) found that a child in allostatic overload has difficulties moving along the arousal states.

Arousal regulation is best understood as the competing forces of the Sympathetic Nervous System's (SNS) activation, fight-or-flight responses, and the Parasympathetic Nervous System's (PNS) inhibition, feed-and-breed responses. In effect, how much activation or recovery is necessary for any task is going to vary from child to child, and from situation to situation. It is important that parents learn to recognize these states of arousal so that

they can adjust through up-regulating or down-regulating their behaviour to maintain optimal regulation.

The brain's reward system can help restore energy; however, when stimulated in excess, it can throw the body out of homeostatic balance. When stressed, the individual goes for quick fix energy sources (super stimu-lants) to maintain energy, even if they are further stressors (Baumeister & Tierney, 2011).

EMOTION DOMAIN

Basic emotions (e.g. happiness, fear or anger) are biological, hard wired, and genetically selected, with specific associated facial expressions and neuro-hormonal events (Greenspan, 2001; Greenspan & Shanker, 2006). More complex emotions however are not reflexive, but rather a response to a basic emotion. Emotion, not biology, comes first.

Affect Diathesis Hypothesis states that babies have precursors of emotion (for example, a happy or distressed state).

The Physical-Emotional Nexus is the mechanism whereby emotion leads to a physical response, which in turn strengthens the emotion, creating a stress cycle.

Basic emotional facial expressions are recognized worldwide and emerge between three and nine months (Ekman, 1970).

Secondary emotions are where there is variation around the world (Izard, 1992).

A physical sensation is attributed to the feeling of being distressed and to learned helplessness (Seligman, 1972).

Selye (1956, 1976) found that negative emotions can burn considerable amounts of energy.

COGNITIVE DOMAIN

Attentional problems are downstream consequences of basic cognitive deficits or challenges. Strengthening the roots of executive functioning can alleviate attentional problems (Greenspan, n.d.; Greenspan & Shanker, 2006). Patterns act as a buffer against stress (Porges, 2011).

Porges (2011) spoke of attention within a trophotropic-ergotropic shift. When focused on a problem, one goes still, ignoring external sensations to focus on the problem. This takes a lot of energy and requires one to be in a state of high tension; therefore, one must have high energy reserves to successfully focus.

Patterns (for example, Motherease) allow for predictability, and that in-cludes the predictability of safety, allowing for stress reduction (Porges, 2011).

SOCIAL DOMAIN

To be successful in social interaction, one must master non-linguistic conventions (Argyle, 2007; Argyle & Dean, 1965). However, with negative bias, incoming non-verbal cues may be interpreted as a threat.

Neuroception is the child's unconscious limbic system that is constantly monitoring the environment for safety or threat (Greenspan & Shanker, 2006; Porges, 2011). Social engagement is the first line of defense.

Co-regulation is a social process by which individuals dynamically alter their actions with respect to the ongoing and anticipated actions of their partners (Fogel, 1993). We can co-regulate via non-linguistics mentioned by Argyle (2007).

Still Face Paradigm is an experiment where a mother faces her baby and holds a "still face," unresponsive to her baby's behaviours (Tronick, Adamson, Als, & Brazelton, 1975).

PROSOCIAL DOMAIN

From Plato's story of trying to steal oneself away from dead bodies, it is tak-en away that humans naturally have these urges, but must strengthen their reason to control their impulses.

Children naturally have the roots for empathy, and it is developed through the dyad.

Dyadic synchrony or engaging in altruistic behaviour produces reward-ing hormones which further act to promote prosocial interactions; this is known as helper's high (Feldman, 2012; King, 2009; Zahn et al., 2009).

Limbic resonance allows a species to have a limbic-to-limbic communication system (Greenspan & Shanker, 2006; Lewis, Amini, & Lannon, 2007). In humans this communication system operates through facial expressions, vocal tone, and so on.

Stress can influence fetal development (Field, Diego, & Hernandez-Reif, 2010; Grandjean & Landrigan, 2014).

Entrenched Behavioural Patterns – canalization is the process of creating specific patterns of behaviours, attractors are the resulting behaviours (see below).

Developmental reactions brought about by natural selection are canalized, whereby the reaction is adjusted to bring about a specific result, regardless of minor variations in conditions during the reaction. These reactions are referred to as canalization (Waddington, 1942).

Attractors are stable patterns that establish in dynamic systems (Fogel, 2013).

Heightened stress is a key attractor of concern in Self-Reg.

Babies are more stressed, and this stress can cause them to burn energy even when they are at rest. In experiments, babies with higher resting heart rates took longer to return to resting heart rate after being stressed (Porges, 2011).

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Self-Regulation, Self-Control, and the Practice of Shanker Self-Reg®

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Abstract

The Shanker Self-Reg® framework, based on the psy-chophysiological understanding of self-regulation and the hier-archy of human stress responses, differs from programs rooted in self-control-based conceptions of self-regulation. Self-Reg is a process rather than a program. It applies to everyone —chil-dren, youth and adults — rather than students in general, or spe-cific age groups or subgroups of students. Self-Reg encourages reflective thinking that helps people understand and respond to stressors and internal states in order to bring online the brain mechanisms that enable exercise self-control, learning and over-all well-being. These differences are illuminated through a com-parison of Self-Reg to two popular self-regulation programs.

Introduction

One of the central tenets in all the work we do with par-ents and educators is that *Self-Reg is a process and not a pro-gram.* But why not both? Why is it so important to draw this dis-tinction, and if it is so important that we avoid seeing Self-Reg

as a program, what sort of process is it and how is this mastered?

The key to answering this question lies in the fundamen-tal Self-Reg principle: “See a child differently and you see a dif-ferent child.” Recognize, for example, when a child is exhibiting stress behaviour rather than misbehaving, and you immediately begin to consider what the stresses might be that are over-load-ing this child. But so much more is involved here than a simple change in perspective. If you see that a child is in fight-or-flight rather than being oppositional, everything about your interaction with that child instantly changes: what you feel and how you re-spond; the subtle cues that you give off in your tone of voice, facial expression, gestures, and so on; and what the child feels and how the child responds.

Such an “aspect-shift” does not come easily, or all at once. For one thing, we ourselves have a limbic system that is easily aroused by a child’s arousal, and our own fight-or-flight reaction is easily triggered when this happens. For another, we have a deeply entrenched mindset that sees all stress behaviour as misbehaviour, and therefore as a sign of weakness or self-indulgence. Then there is the fact that we have a scientific culture telling us that it is relatively straightforward to produce the behaviours that we want, and if you are not seeing the intended results you need to try harder. And there are insidious thoughts, like: “Spare the rod and spoil the child,” or “That’s how I was raised and I turned out okay.”

In practicing Self-Reg, we are forever asking: “Why am I seeing this behaviour or reaction?”: bearing in mind that every child is different and every situation is different. Accordingly, Self-Reg is inherently flexible and adaptive. It demands obser-vation, reflection, trial and error, and self-awareness. It sees the learning curve as open-ended and, for that matter, endless. And above all, it seeks to transform a me–them relationship, where children or students are seen as needing to be controlled, to an I– thou relationship that is nurtured by understanding and insight.

All of these reasons help those of us who are practi-tioners to understand why it is so important to see Self-Reg as a process and not a program. One of the biggest problems with many programs – even, as we’ll see below, programs that are ex-plicitly intended to foster self-regulation – is that they may actu-ally impede the sort of reflective thinking that Self-Reg inspires. There is a danger here that the authoritarian mindset towards children gets transferred to those following the program. That is, the drive for inquisitiveness is replaced by the demand for fidelity; thinking that should be creative becomes regimented. And the demarcation between self-control and self-regulation is blurred: in some cases, even obliterated.

Distinguishing Between Programs for Self-Control and Self-Regulation as a Process

There is a fundamental conceptual distinction between self-control and self-regulation. It is a critical distinction because the two concepts are frequently confounded (Shanker, 2016). As a result, it is not at all clear, when a program of some kind has shown to have had some positive effects on children's attention, mood, or behaviour, whether these were due to the self-control or the self-regulation component, or possibly a synergistic effect between the two. The second reason why it is vital to be clear on this distinction is that it brings to the fore the question of what we should be endeavouring to teach: is it self-control, or is it self-regulation?

The answer for Self-Reg is clearly self-regulation. Self-reg-ulation is, in fact, what makes self-control possible. In a state of heightened stress, a child is unable to benefit from training designed to foster self-control. The key to changing a child's trajectory is to identify and reduce his stress load, rather than trying to teach better self-control; the latter emerges naturally as a result of improved self-regulation. But this in turn raises the question: How do we "teach" self-regulation at a universal level, especially considering the additional challenge that what is a stressor for one child may not be for another, and that, even for the same child, what may be a stressor in one moment may not be in another when the child is in a different physical or emotional state.

It is this individual variability of stress-reactivity that represents our greatest challenge as we undertake to institute and assess universal approaches to enhancing self-regulation. Clinical studies have demonstrated that it is indeed possible to enhance a child's self-regulation, and that doing so results in meaningful developmental changes (Casenhiser, Binns, McGill, Morderer, & Shanker, 2015; Casenhiser, Shanker, & Steiben, 2013). But again, do we take such a clinical approach to scale to help those children who might be struggling, but also to enhance the self-regulation of all children? And if so, how?

To complicate the issue still further, what proves to be effective might vary from person to person, classroom to classroom, school to school, community to community. So rather than thinking of instituting a universal self-regulation *program,* we need to think of self-regulation as an educational *process.*

One response has been to teach children various types of relaxation and meditation practices in order to help them learn how to control their thoughts and emotions. Here too we see mixed results: many children find such activities taxing because it's dysregulating in some way. The dysregulation is unique to the individual. Perhaps the child is not yet developmentally ready to focus on her breathing, or to sit still for longer than a few min-utes because she has not yet developed sufficient "emotional intelligence" to understand, much less identify and express, what she is feeling, or because of sensory-motor compromises that render these exercises highly stressful rather than calming.

It is understandable that educators might be drawn to programs that promise a "quick fix" to problems in self-regulation, but our experience has been that there is no such thing: especially with children. All too often, the quick fix in question turns out to be trying to teach the children *about* self-regulation, as opposed to helping them learn *how* to self-regulate. Take a concept like *calmness,* which is actually quite complicated: it has a physical component (the feeling of relaxed muscles, your heart and breathing slowing down); an emotional component (the enjoyment of the feeling of calming down); and a cognitive element (the awareness of what one is experiencing). Without a mastery of all three elements, children can easily confuse being *quiet* with being *calm*. They really don't know, in their body, what "calm" means, let alone regard this as a pleasant state. In fact, just the opposite is often the case: they might comply, but only from a wish to please their teacher, or because of the power dynamics, and not from any genuine awareness of their tension and a desire to release it. So, it turns out once again that it is self-control that we are unwittingly working on, and not self-regulation.

A self-control focus overlooks the major question of whether such programs are beneficial. Even if it were shown that teaching children to control their impulses is effective in primary school, as has been argued, we would still be left with the serious question of whether it would be beneficial to attempt something similar in early learning centres and older grades, or whether using behaviour modification techniques to try to instil

self-control in children might lead to problems in mood, attention, and behaviour.

The child might well become more compliant – at least for the short term – as a result of such self-control oriented practices, while undergoing and even becoming habituated to a state of heightened arousal. It is important to keep in mind that being *quiet* and *still* should not be conflated with being *calm and attentive*. These concepts belong to very different families with very different histories and, indeed, are subserved by very different parts of the brain. The former is concerned with acquiring the "cognitive competencies" (Mischel, 2014) and even the "will-power" (Baumeister & Tierney, 2011) to inhibit impulses and ignore distractions; the latter is concerned with understanding and reducing the causes of heightened arousal that leads to impulsivity and distractibility (Shanker, 2012). If learning and well-being are our priorities, we are after calm and attentive; quiet and still denotes compliance (or worse, a "freeze" response to stressors), and these states seldom live side by side.

Comparing Approaches to Developing Students' Self-Regulation

Programs targeting outcomes of self-regulation are used in schools. Consider the challenges discussed of the common confounding of self-control and self-regulation in the psycho-physiological sense and it becomes clear that there are not only different approaches to developing self-regulation in students, but also different theoretical foundations of these programs.

While they may appear to be interchangeable, they may in fact be working on very different priorities. Two common programs we have come across in North American schools that address self-regulation are: Zones of Regulation® and MindUp®. With a goal of clarifying similarities and differences among these self-regulation–focused approaches, we undertook a scan of these two programs alongside the Shanker Self-Reg® frame-work (see Figure 1).

	Zones of Regulation®	MindUP®	Shanker Self-Reg®
Who?	Leah Kuypers (MA Ed, OTR/L, ASD Res.) – 2011	The Hawn Foundation, founder Goldie Hawn – 2003	Stuart Shanker (DPhil), The MEHRIT Centre – 2012
What?	A systemic, cognitive approach used to teach self-regulation by categorizing all the different ways we feel and states of alertness into four concrete zones.	A social-emotional learning curriculum intended to be an integral part of a classroom.	A method for understanding stress and managing tension and energy; a process rather than a curriculum or a program
- Regulation of Self - Definition	"the ability to do what needs to be done to be in the optimal state for the given situation" A life-long process Successful self-regulation via three critical neurological components: • sensory processing; • executive functioning; • emotional regulation.	"MindUP is dedicated to the belief that the child who learns to monitor his or her own senses and feelings becomes more aware and better understands how to respond to the world reflectively instead of reflexively." **Self-management:** regulating emotions to handle stress, control impulses, and persevere in overcoming obstacles	"how people manage energy expenditure, recovery, and restoration in order to enhance growth. Effective self-regulation requires learning to recognize and respond to stress in all its many facets, positive as well as negative, hidden as well as overt, minor as well as traumatic or toxic."

		Zones of Regulation®	MindUP®	$
Central Tenets		Aims to teach students how to become more aware and independent in: controlling their emotions and impulses; managing sensory need; improving ability to problem-solve conflicts. In doing so, aims to "teach students to figure out what zone is expected in given circumstances. If their zone doesn't match the environmental demands and the zones of others around them, you will be teaching strategies to assist in moving to expected zone."	SEL curriculum is intended as integral part of a classroom, with a focus on: • Self-awareness • Self-management / self-regulation • Social awareness • Relationship skills • Responsible decision-making Core Practice: deep belly breathing and attentive listening	Involv the tr of the respo learni brain and t guidi Shan unive a targe behav progr Self- not a pro are ca regul the ag level; Each cultu holds exper There way t There fixes;

	Zones of Regulation®	MindUP®	Shanker Self-Reg®
Tenets Central			Self-Reg is a continual and reflective process; Self-Reg is for everyone, it is not just about children and youth; The well-being of children is inseparable from the well-being of critical adults in their lives.
Tools Taught & Practiced	Sensory supports Calming techniques Thinking strategies	Core Practice (CP) Mindful behaviour	The Shanker Method® Dynamic System of the 5 Domains
Audience Intended	Two to four students with the same cognitive abilities working with one facilitator or eight to ten students working with two facilitators; from 4 years old at or above average intellect.	Classrooms of students from Pre-K to Grade 8 (material tailored for three separate grade segments: Pre-K–Grade 2; Grade 3–5; Grade 6-8).	Everyone (all ages, cultures, contexts).
Delivery	Anyone (parents/ teachers/occupational therapists [OT]).	Classroom teachers.	Anyone (all ages, cultures, contexts).

	Zones of Regulation®	MindUP®	Shanker Self-Reg®
Assessed is - Self How	Check-ins (or communication boards) Informal observation of student behaviour More formal observation of student behaviour, including data collection and point sheets	https://www.edutopia.org/blog/building-sel-skills-formative-assessment-robert-marzano : R.J. Marzano, adapted from "Using Formative Assessment w/ SEL Skills" (2016) *not specific to MindUP program*	Rubric for Self-Reg Competencies (educators assessing implementation) Rubric for personal Self-Reg (adults) *Further assessment tools in process of being created*
/Influences pinnings Under-	Cognitive Behaviour Management Central Coherence Theory (Frith, 1989) Systemizing Theory (Baron-Cohen, 2006) Social Thinking (Winner, 2000) The Alert Program (Williams & Shellenberger, 1996) The Incredible 5-Point Scale (Buron & Curtis, 2004) "Phases of control" (Kopp, 1982) Self-management (Dawson & Guare, 2009) SCERTS Model (Prizant, Laurent, & Rydell, 2006) Theory of Mind (Frith, 1989) Enactive Mind approach (Klin, Jones, Schultz, & Volkmar, 2003)	Developmental Cognitive Neuroscience Mindfulness training Social and Emotional Learning (SEL) Positive psychology	The Triune Brain (Maclean, 1990) Child development (Greenspan, 1997) Neuropsychology (Schore, 1994) Psychophysiology (Porges, 2011) Psychology of parenting (Baumrind, 1967) Secondary altriciality (Gould, 1977; Portmann, 1961) Homeostasis / fight-or-flight (Cannon, 1932) Dynamic Systems Theory (Fogel, King, & Shanker, 2007) Canalization (Waddington, 1942) Coregulation (Fogel, 1993)

	Zones of Regulation®	MindUP®	Shanker Self-Reg®
Available /Resources Tools	The Zones of Regulation®: A Curriculum Designed to Foster Self-Regulation and Emotional Control (2011) www.zonesofregulation.com/ The Zones of including 35 full-color and black-and-white reproducibles Regulation® App Exploring Emotions App	The MindUP Curriculum: Brain-Focused Strategies for Learning and Living, Grades Pre-K–2. / Grades 3–5 / Grades 6 –8 (2011) https://mindup.org/ www.thehawnfoundation. MindUP™ Digital Portal 12-month workshop for parents MindUP™ for Therapists Guide	Self-Reg: How to Help Your Child (& You) Break the Stress Cycle & Successfully Engage with Life (2016) Calm, Alert and Learning: Classroom Strategies for Self-regulation (2012) www. selfregulationinstitute.org Reg® Tool Kit for EducatorsSelf-Reg Parenting Magazine Consultation for parents and educators Self-Reg eSchool (Parent Portal, Portal Plus, Foundations Courses, Facilitator's Courses, Master Classes, webinars, workshops, symposium)
Research /Program Framework	Described as "practice based on evidence versus an evidence-based practice" (Retrieved from www.zonesofregulation.com) Two research studies completed and two progress	A peer-reviewed program in use for over ten years, accredited by CASEL Schonert-Reichl, 2014; Schonert-Reichl et al., 2015; Maloney, Schonert-Reichl, Whitehead Arruda, &	Research in progress in five areas: The 5 Domains of Stress Transition Conditions Between Positive & Negative Stressors Reframing Scientific Theories Review of Self-Reg Measures

	Zones of Regulation®	MindUP®	Shanker Self-Reg®
/Program Framework of Steps Basic	18 sequenced lessons, 30–60 min./lesson **RED:** extremely heightened alertness and **YELLOW:** elevated emotions and alertness **GREEN:** calm alertness and optimal learning **BLUE:** low state of alertness and down feelings	Fifteen sequenced lessons, 10–30 min./day Strategies integrated throughout class content **Getting Focused** (3 lessons) **Sharpening Your Senses** (6 lessons) **All About Attitude** (3 lessons) **Taking Action Mindfully** (3 lessons)	**The Shanker Method™:** **Reframe** the behavior **Recognize** the stressors **Reduce** the stress **Reflect**: enhance stress awareness **Respond:** develop personalized strategies to promote resilience and restoration

The Shanker Self-Reg® framework, which is based on the psychophysiological understanding of self-regulation, is set apart from the other two programs compared in Figure 1 be-cause it addresses the hierarchy of stress responses as outlined by Porges (2001): social engagement, fight-or-flight, and freeze. Where MindUp and Zones of Self-Regulation require a state of control to self-manage, engage in, and respond to the stressors experienced in a given moment or in reflection, the practice of Self-Reg encompasses the fight, flight, and freeze states, and neuroception in general – the limbic system's response to feeling unsafe. Note that this is different than thinking about or talking about these states. In Self-Reg the focus is on responding to these states. This is precisely the reason why self-regulation makes self-control possible: it brings the brain mechanisms involved "online" and ensures they are able to respond with control when

needed, although it should be noted that, the better the child self-regulates, the less the need for self-control.

Conclusion

As is clear from the foregoing, the reflective practice of Self-Reg is about so much more than just instituting an attitudinal shift; it is about developing an understanding of behaviour that is grounded in the recent advances that have occurred in psychophysiology and neuroscience. The more we learn about the dynamic interplay between neocortical and subcortical processes, the clearer it becomes that the emphasis on self-control is often misplaced and, in many cases, harmful.

To this end, The MEHRIT Centre (TMC) provides resources on Self-Reg, including blogs, printable information sheets, videos, podcasts, a parenting magazine, newsletters, and presentations. Opportunities to take courses and become certified in the Foundations of Self-Reg, or to become a facilitator of others' learning the method, are available, as are face-to-face learning options and online communities.

Our experience to date has been that it is only by engaging in this sort of intensive learning experience that self-regulation truly comes to life: not simply in terms of the "new way of seeing children" described above, but also in terms of a new way of seeing ourselves, our own stresses, and the need to work on our own self-regulation. And this may be the most important point of all: Self-Reg is a process of change. And it applies to all: children, teens, parents, teachers, young adults, seniors. Everyone.

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Examining the Measures:

Review of Self-Reg Components Captured in Current Measures Labelled “Self-Regulation”

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Abstract

An examination of measures designed to assess self-regulation was undertaken to assess how well they are aligned with Shanker Self- Reg®. A literature search turned up 11 tools designed to provide measures of self-regulation. Analysis revealed that all tools primarily addressed prefrontal cortex functions and none adequately addressed all five domains of the Shanker Self-Reg® framework (biological, emotion, cognitive, social and prosocial). The cognitive domain was the focus of most of the tools reviewed, although the authors noted a historical trend towards conceptualizing self-regulation as a multi-domain concept. Full alignment with Self-Reg would require measures to address the dynamic nature of all five domains along with subcortical processes and the interplay between subcortical and neocortical systems and processes.

In Self-Reg, Shanker defines self-regulation as the ability to manage stressors across five domains: biological, emotion, cognitive, social, and prosocial, and then to subsequently recover

(2016). This definition is based on the psychophysiological view of self-regulation developed by historic theorists and researchers through to current scientists (see Shanker, 2016 for a review). A stressor, by definition, is any stimulus that triggers a physiological response that serves to keep an internal homeostatic system (or sys-tems) operating within its optimal functional range. The energy expended in such processes must be restored in order to avoid slipping into a state of allostatic overload, in which recovery is compromised and mood, behaviour, learning, and physical health are impaired.

One of the big challenges when doing research in this area is that there have been 447 different definitions of self-regulation (Burman, Green, and Shanker, 2015). These definitions belong to different disciplines (for example, education or mental health) that are focused on different contexts (for example, university learning or preschool behaviour). Many view self-regulation as a dispositional and domain-specific attribute (for example, a cognitive ability or set of cognitive abilities) that is relatively static (for example, emotional intelligence). Self-Reg, in contrast, sees the ability to manage stress as a fluid and dynamic process that is continually refined across the lifespan.

Measures developed to serve other disciplines often do not align with the psychophysiological view of self-regulation on which Self-Reg is based. The problem here is that those seeking to assess Self-Reg may gravitate towards published tools that are labelled as self-regulation, but are addressing something

completely different. It is clear, then, that to advance the science of Self-Reg, we need to address the question: Are any of these tools, or a combination of these tools, or parts of these tools aligned with Shanker's definition of self-regulation?

Measures of Self-Regulation and Self-Reg

To resolve this question, we undertook an analysis of the existing literature. The analysis involved an examination of measures that included the term self-regulation, self-regulating, self-regulatory, or self-regulated in the title. Using Google Scholar as our primary database, due to its comprehensiveness, we established inclusionary criteria for empirical research articles as follows: (a) the term self-regulation, or a variant (see above), must have been included in the title, (b) the paper had to have been published by more than one author or research group to eliminate any one-offs (tools developed for a single study but not used beyond), and (c) the measurement had to have been cited in an article within the last 20 years, to ensure that it was still in relatively current use. All articles were found using a search query for "self-regulation," or a variant, in conjunction with one of the following terms: scale, inventory, assessment, or questionnaire. Measurements identified in this search were then submitted to an item-by-item analysis in order to identify which items, if any, tapped into biological, emotion, cogni-tive, social, and/or prosocial facets of Self-Reg. Additionally, the discipline or field for which the measure was primarily developed (for example, psycho-education, mental and physical

health, development) was identified.

One limitation of this search was that biometric tools or assessments of stress and/or anxiety processes were not included in this analysis, although the theoretical underpinnings of Self-Reg lie in this area. For a review of biometric tools , including body-and brain-based measures, see “Measuring the Foundations of Self-Reg” (this volume). A review of tools that measure aspects of Self-Reg but do not use the term self-regulation is forthcoming.

Stressor Domains

Shanker (2016) identified five domains of stressors that require energy to be expended. We examined each of the measures to identify which domains of stressors were addressed by the assessment items. Items were identified as measuring *biological* stressors if they assessed either internal states (for example, quality of sleep, appetite and diet, feelings of illness/wellness, individ-ual differences, disabilities) or potential sensory irritations (for example, eye fatigue, noise, visual screen-time, sensory pro-cessing issues). Items that assessed the experience of feeling or coping with emotion (for example, upset/unease, homesickness, test anxiety, excitement) were classified as tapping the *emotion* domain. By far the most often assessed was the *cognitive* domain. Items were identified as cognitive when they measured either cognitive processes (for example, attention, motivation, dis-tractibility, metacognition) or thinking-based strategies or as-sessments (for example, self-efficacy, problem-solving, self-ap-

praisals). The social domain included items that asked about the impact of interpersonal interactions on the individual (for example, personal and professional/educational relationships, social interactions with others, giving and receiving social cues). Finally, items were assessed as tapping the prosocial domain if they assessed the impact of empathy or social mores on the individu-al (for example, the impact of others' stress or distress, feeling of societal expectations, cultural expectations). The items were classified according to domain by each author independently. Conflicts in the classification were resolved using consensus.

Measures were identified as "psycho-education" if they were designed to assess self-regulation skills in educational settings (for example, school, childcare, learning environments). Measures that were designed to measure self-regulation as a general life skill or for clinical populations (for example, those with addictions) were categorized as "mental health" tools. Finally, tools were categorized as "health" measures if they were designed for general medical use (for example, for those with illness or injury) or for use within fitness settings (for example, exercise, lifestyle). A summary of the domains of stressors assessed in each domain is outlined in Table 1.

Table 1. Representation of Shanker's Five Domains of Self-Reg across Popular Self-Regulation Measures

Measure	Context	Domain				
		Biological	Emotion	Cognitive	Social	Prosocial
Self-Regulation Strategy Inventory – Self-Report (SRSI–SR) (Cleary, 2006)	Psycho-education			✓	✓	
The Adolescent Self-Regulatory Inventory (ASRI) (Moilanen, 2007)	Psycho-education	✓	✓	✓		
Self-Regulatory Inventory (Hong & O'Neil, 2001)	Mental Health			✓		
Self-Regulation of Learning Self-Report Scale (SRL–SR)	Psycho-education & Health			✓		
(Toering, Elferink-Gemser, Jonker, van Heuvelen, & Visscher, 2012) Self-Regulation Scale (SRS) (Schwarzer, Diehl, & Schmitt, 1999).	Mental Health		✓	✓		

Measure	Context	Domain				
		Biological	Emotion	Cognitive	Social	Prosocial
The Motivational Strategies for Learning Questionnaire (MSLQ) (Pintrich & De Groot, 1990)	Psycho-education	*	✓	✓	*	✓
The Self-Regulation Questionnaire (SRQ) (Brown Miller, & Lawendowski, 1999)	Mental Health			✓		
The Short Self-Regulation Questionnaire (SSRQ) (Carey, Neal, & Collins, 2004)	Mental Health			✓		
Self-Regulation Questionnaire Pro-Social (SRQ-P) (Ryan & Connell, 1989)	Mental Health			✓		
Self-Regulated Learning Interview Schedule (SRLIS) (Zimmerman & Martinez-Pons, 1988)	Psycho-education			✓		

Measure	Context	Domain				
		Biological	Emotion	Cognitive	Social	Prosocial
Preschool Self-Regulation Assessment (PSRA) (Smith-Donald, Raver, Hayes, & Richardson, 2007)	Psycho-education		✓	✓	*	

Note: A check mark signifies a domain addressed within the measure. An asterisk indicates a domain that is only minimally or indirectly assessed.

Analysis of Measures

The analysis of the identified measures revealed a historical trend towards increasingly conceptualizing self-regulation as a multi-domain construct and considering the context of the behaviour within the tool. Measures developed in the 1980s focused predominantly on the metacognitive aspects of self-regulation alongside the application of cognitive strategies, both of which are cognitive domain factors. For example, in one of the first self-regulation measures developed by Zimmerman and colleague, the focus was solely on cognitive factors, such as self-control and self-monitoring abilities and beliefs, with little consideration of intra-personal factors impacting the ability to manage stressors and cope in a learning environment (Zimmer-man & Martinez-Pons, 1988; the Self-Regulated Learning Inter-view Schedule).

As research on self-regulation advanced into the 1990s, the instruments that were developed started to hone in on measures of very specific cognitive sub-skills, as exemplified by the Self-Regulation Scale, which assesses attention-control (Diehl, Semegon, & Schwarzer, 2006), and the Self-Regulation Questionnaire (Brown et al., 1999), which assesses cognitive skills and abilities as a mental capacity across contexts. This focus on the cognitive domain is a fundamental feature underlying all the examined measures of self-regulation. One measure that does address the other domains is the Motivational Strategies for Learning Questionnaire (MSLQ), which measures cognitive factors in a learning context (for example, education), but considers factors impacting cognition across all five domains. For example, the confluence of the emotion and cognitive domains was tapped with Item Number 19 of the scale, which asked uni-versity students to respond on a likert scale whether they have, "an upset/uneasy feeling when [they] take an exam." The impact of prosocial learning was assessed in the Item Number, "I think about how poorly I am doing compared to other students". The limitation with the MSLQ is that the measure focuses predomi-nantly on the cognitive impacts of these stressors, and pays little attention to the impacts of the other domains, where only one item of 81 itemed scale adequately assessed each of the remain-ing four domains. Moreover, the questionnaire is limited insofar as it conceptualizes cognition as an outcome and not a stressor in and of itself. Accordingly, while the measure considers multiple domains on the surface, it reflects a definition of self-regulation

that is focused on managing or controlling stressors, rather than understanding the impact of stressors across domains or the impact of subcortical processes and conceptualizing "Self-Reg" through an understanding of the "triune brain."

Many of the measures analyzed purport to measure biological/physiological, emotion, social, and prosocial factors (see, for example, the Self-Regulation Questionnaire-Prosocial). However, a review of these measures reflected only minimal or indirect assessments of these domains. For example, in the afore-mentioned Self-Regulation Questionnaire-Prosocial, stressors from the prosocial domain are only indirectly assessed by items asking about cognitive appraisals of this domain (for example, "Why do you keep a promise to a friend?") with a choice selec-tion provided for the rationale of the question. Here, the focus is on the thinking, or cognitive assessment, rather than the assessment of the prosocial factors that are impacting the individual. The minimal or indirect reflection of non-cognitive domains underplays not only the importance of considering stressors across domains, but also how these stressors impact coping and performance. Mea-sures with this limitation are indicated in Table 1 using an asterisk.

One important observation that we made during our analysis is that these measures typically do not include items that look at self-regulation and the impact of stressors as a dynamic and evolving process. For example, few questionnaire items attempt to contextualize the impact of stressors across domains, such as indicating the impact of a biological stress-

or on problem-solving. One very rare exception from the Adoles-cent Self-Regulatory Inventory is “I have trouble getting excited about something that is really special when I am tired”, an item that looked at the interplay between emotion and biological factors.

Given that self-regulation in the reviewed measures re-fers to stress-management and is focused on cognitive performance as an outcome and not as a stressor as well, these tools do not re-flect the Self-Reg model as conceptualized by Shanker (2016). A measure that is consistent with Self-Reg would require a five-do-main model, not simply as some sort of additive measure, but rather to reflect how domains impinge on and amplify each other. For example, what might be an intolerable emotional or social stress when the individual is experiencing a period of low-energy (for example, fatigue) and high-tension (for example, high levels of stress overall) might be tolerable and even positively arousing when the individual has high levels of energy and low levels of tension. The context is an essential consideration and must be part of the assessment.

Conclusion

Many of the existing measures of self-regulation assess prefrontal cortical functions (cognitive processes such as mental strategies, planning, problem-solving, and self-monitoring). There are few measures that focus on subcortical systems (for example, stress responses). Self-Reg shows us that an adequate measurement of self-regulation must capture the interplay

between neocortical and subcortical processes and the inter- (biological, emotional, and cognitive) and intra-processes (social and prosocial) impacting an individual.

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Appendix

Scale	Domain				
	Biological	Emotion	Cognitive	Social	Prosocial
Self-Regulation Strategy Inventory –Self-Report (SRSI –SR) (Cleary, 2006)				*26	

The Adolescent Self-Regulatory Inventory (ASRI) (Moilanen, 2007)	1, 35**	34, 35**			
Self-Regulatory Inventory (Hong & O'Neil, 2001)					
Self-Regulation of Learning Self-Report Scale (SRL–SR) (Toering et al., 2012)					
Self-Regulation Scale (SRS) (Schwarzer et al., 1999).		*3, *9			
The Motivational Strategies for Learning Questionnaire (MSLQ) (Pintrich & De Groot 1990)	28	19		30	3
The Self-Regulation Questionnaire (SRQ) (Brown et al., 1999)					
The Short Self-Regulation Questionnaire (SSRQ) (Carey et al., 2004)					
Self-Regulation Questionnaire Pro-Social (SRQ-P) (Ryan & Connell, 1989)					
Self-Regulated Learning Interview Schedule (SRLIS) (Zimmerman & Martinez-Pons, 1988)					
Preschool Self-Regulation Assessment; (PSRA) (Smith-Donald et al., 2007)					

Note: ** Denotes an attempt to look at the interplay between stressors in two domains. The numbers specify which items of the scale/measure tapped into the domain.

Measuring the Foundations of Self-Reg:

Bio-physiological Assessments of the Stress Response

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Abstract

The Self-Reg Framework (Shanker, 2016) is a comprehensive model of self-regulation grounded in psychophysiolo-gy. This paper presents a literature review of existing physio-logical measures of self-regulation and discusses their potential for research relevant to the Self-Reg framework. Although many of these brain- and heart-based measures provide indicators of a stress response, few are able to provide information about the causes of the stress response and the ability of the individual to respond and recover. We also note challenges inherent in phys-iological measurements of self-regulation including the invasive-ness and complexity in collecting physiological data and their limitations in assessing self-regulation as a process. The tools reviewed have potential in measuring some of the key aspects of the stress response and provide opportunities for future applications of use of physiological measurement.

The Self-Reg framework represents a comprehensive model of self-regulation that is grounded in the psychophysiological tradition initiated by Claude Bernard (1865), Walter Cannon (1939), and Hans Selye (1946), and culminating in the work of Steven Porges (2011). Assessments of the stress response based in this framework encompass all five Self-Reg domains – biolog-ical, emotion, cognitive, social, and prosocial. This paper focuses on measures in the biological domain.

Our bodies provide evidence of the stress response. For example, during a sympathetic autonomic response to stress (often termed the fight-or-flight or freeze response), the body prepares for threat with physiological changes that include heart rate changes, pupil dilation/visual perceptual responses, and neu-rological processing shifts. With modern technology, these physiological indicators of a stress response can be measured. In this paper, we review three major categories of physiolog-ical measures that indicate a stress response – eye-related, brain-related, and heart-related (Mandrick, Peysakhovich, Rémy, Lepron, & Causse, 2016), as well as a few additional measures beyond these categories,and critique their usefulness as indicators of a stress response for Self-Reg research.

Eye-Related Measures

The responsivity of the eye to autonomic arousal (pu-pil dilation, gaze, attentional capture) has long been established. Stress-related eye-based measurement includes using technolo-

gy in the following areas: (a) tracking specific eye movements (focus of visual attention); (b) gauging eye blink response to capture an individual's level of physiological arousal based on the timing and magnitude of the startle response; and (c) using pupillometry, which involves measuring the involuntary diameter/dilation of the pupil when an individual is exposed to specific stimuli (Beatty & Kahneman, 1966). Each of these measures can be used to gauge a stress response, but some measures, such as eye gaze, can also provide information about the visual and social stressors impacting an individual.

Eye Glaze

Eye gaze is an example of an eye-based measure that provides information about stressors. Eye tracking software can be used to track eye gaze to determine an individual's focus of attention on specific stimuli, such as specific parts of another person's face (Bal et al., 2010). For example, eye gaze between mother and child dyads can be tracked as a behaviour related to mental health and co-regulation (Warnock, Craig, Bakeman, Castral, & Mirlashari, 2016). Eye tracking can provide clues about what an individual may be looking at, but it provides limited information about the impact of that visual information on the stress response.

Eye Blink

Eye blink has been related to stress and has been better established as an indicator of an autonomic response. White and her colleagues (2014) studied eye blink responses elicited by startle and suggested a dimensional model with neurophys-iological foundations. They found that the rate of blinking

increased when stress increased. Eye blink can be measured concurrently with eye gaze with the addition of a camera that captures images of the blink during the tracking process.

Pupillometry

Similarly, pupillometry, has also been validated as an indicator of affective processing (Mandrick et al., 2016). The measurement of a pupil's diameter can also be captured with the recording of the individual's eye. Pupillometry can indicate the presence of high mental effort and threat (that is, stressful sound) with an increase in tonic pupil diameter and decrease in phasic pupil response (Mandrick et al., 2016).

Eye-based measures, as outlined above, can provide limited but important information about the interplay of stressors and their physiological impact, a key principle underlying Self-Reg. Eye-tracking may only provide data on where an individual is looking, but, with the addition of information from observing eye blink and pupillometry, measurement of eye responses can provide information about an autonomic stress response. How-ever, currently these measures cannot be taken naturalistically.

The equipment and techniques they require are currently lab-

based and individuals may demonstrate increased responses simply as a result of the unfamiliar lab experience itself.

Brain-Related Measures

The issue of responsivity to the assessment location and/

or to the equipment is also a consideration for brain-based mea-

surements. Empirical literature on brain-based measurement (neuroimaging) and how it relates to stress is much more robust than that on eye-based physiological measurement. Neuroimaging includes magnetic resonance imaging (MRI), functional MRI (fMRI), diffusion tensor imaging (DTI), and electroencephalography (EEG). All of these systems can be used to infer activity in the brain that reflects psychophysiological processes.

MRI

MRI allows researchers to examine static and moving images demonstrating neural activation when a subject is presented with specific stimuli. It can be used to examine prefrontal activation associated with the body's stress sys-tem. For example, the presence of a close social compan-ion reduces neural activity in regions associated with neg-ative affect, threat, fear, or pain, such as the right anterior insula and superior frontal gyrus, and activates areas of the prefrontal cortex that help an individual down-regulate and reduce a fight-or-flight response, such as the ventro-medial (Hostinar & Gunnar, 2015). MRI can be used to measure the autonomic limbic and prefrontal neural re-sponses to meditation and mindfulness (Annells, Kho, & Bridge, 2016; Boccia, Piccardi, & Guariglia, 2015). It can also be used to measure temporal (in-time) responses to imagined social situations (Zahn et al., 2009), as well as brain activity during socio-moral tasks requiring interpre-tive judgement across ages (Barrasso-Catanzaro & Esling-er, 2016; Weiskopf et al., 2004; Weiskopf et al., 2003).

fMRI

fMRI also enables researchers to study images of neural activation in response to specific stimuli. Real-time fMRI feedback has been used to allow people to observe and control changes to their neural responses (Weiskopf et al., 2004; Weiskopf et al., 2003). It shows promise for enabling the study of the potential ability to connect behavioural and cognitive responses with physiological brain activation, particularly for anterior cingulate cortex (ACC) activation and its role in self-regulation.

DTI

The newest means of neural measurement is diffusion tensor imaging, which shows the interconnectivity between brain areas (Annells et al., 2016; Tang, Holzel, & Posner, 2015). Although quite new, DTI shows potential in regard to self-regulation's interconnected nature and, in the future, may provide clues about how the domains might be neurologically connected within the different areas of the brain (that is, how the limbic system may be connected to the social, emotional, or executive functioning/cognitive centres of the brain).

EEG

EEG measures electrical activity of the brain by record-ing brain waves via a net-like cap embedded with sensors. Where fMRI data is based on blood flow within the preceding four to six seconds, the event-related potential (ERP) mea-sured by EEG is a more direct measure of neural activi-ty connected to real-time stimuli (Amodio, Bartholow, & Ito, 2014). Also, because it is quite tolerant of movement, more realistic stimuli can be used, including real people

and videos (Van Hecke et al., 2009), which is more appropriate to capturing the process of individual self-regulation in response to a variety of naturalistic stressors across domains. Moreover, EEG is silent, unlike MRI and fMRI, and much more portable than many other techniques, making it effective for the measurement of self-regulation within familiar daily environments.

In relation to aspects of self-regulation, including individ-ual response to stimuli based on an individual's current state, as well as the resultant effortful control, EEG has been used to measure brain indications of inhibitory con-trol and cortical activation across ages (Lamm & Lewis, 2010), neural response to the faces of others (Van Hecke et al., 2009), neural response to risky performance (Segalow-itz et al., 2012), effortful control in terms of the prefron-tal cortex's connection to voluntary control (Smith, Diaz, Day, & Bell, 2016), structural brain maturation of impulse control, attention, executive function (Fjell et al., 2012), and amygdala activity involved in self-regulation via neu-rofeedback (Meir-Hasson et al., 2016)

Unfortunately, MRI and fMRI studies are limited as measures of Self-Reg because of their lab requirements, mak-ing them unusable in naturalistic settings where self-regulation can be measured with high validity, and also because the known noise and confines of the scanners can affect an individual's physiological arousal levels (Annells et al., 2016). The fright-ening and unfamiliar experience of being assessed with MRI and fMRI can confound the data and undermine the ability to form conclusions about the process of self-regulation.

EEG is much more mobile and flexible than MRI or fMRI. Portable systems are available that can be used outside the lab, although the placement of the cap and the recording devices for the sensors does limit the use of EEG. As well, a

long-standing limitation of EEG is that the data can only indicate that the brain has been activated in a relatively general location, not the nature of why that response occurred (Amodio et al., 2014). Not only that, but also a skilled technician is needed to interpret the data generated by an EEG. Notwithstanding these limitations, EEG is particularly promising as a method that is readily combined with other measures of physiological responses.

Heart-Related Measures

Contemporary research in self-regulation is focused on the brain–body connection (Bal et al., 2010; Geisler & Kubiak, 2009; Patriquin, Lorenzi, & Scarpa, 2013; Porges et al., 2013; Porges & Furman, 2011). In other words, our nervous system connects our heads, where we read our environment for safe-ty cues, and our hearts, where we experience physiological re-sponses. Each helps the other in perceiving and responding to incoming stressors. The research uses measures of vagal tone, including Heart Rate Variability (HRV) to understand the psy-chophysiological foundation of self-regulation, as described below.

Polyvagal Theory describes how risk and safety cues that are continually monitored by our nervous systems influence our physiology and psychology (Porges, 2011). This refers to our ability to remain in a calm, alert, self-regulated autonomic state (Porges, 2007). Porges' work (2007, 2009, 2011, 2015) requires much technological and statistical precision in using electrocardiogram (ECG or EKG) data to calculate a measure called vagal tone, which is thought to provide an important marker of human self-regulatory ability and adaptation to environmental challenges.

Heart Rate Variability

Researchers have used HRV measures to examine many different aspects of self-regulation, including the following:

- physical health (Kim et al., 2015; Huikuri et al., 1999; Grieco, Colberg, Somma, Thompson, & Vinik, 2014);
- mental health and internalizing disorders (Cicchetti et al., 2014; Bradley et al., 2010; Scott & Weems, 2014; Bosch, Riese, Ormel, Verhulst, & Oldehinkel, 2009),
- self-control (Geisler & Kubiak, 2009);
- aggression (Gower & Crick, 2011);
- addictions and risky behaviour (Quintana, Guastella, MGregor, Hickie, & Kemp, 2013; Kniffin et al., 2014; Buckman, White, & Bates, 2010);
- social interaction (Shahrestani, Stewart, Quintana, Hickie, & Guastella, 2014; Movius & Allen, 2005);
- emotion regulation/control (Hastings et al., 2008; Pu, Schmeichel, & Demaree, 2010; Guy, Souders, Bradstreet, DeLussey, & Herrington, 2014; Davis, Quiñones-Cama cho, & Buss, 2016);
- mindfulness, yoga, or other body–mind interventions, in cluding breathing (Tang et al., 2009; Peng et al., 2004; Delgado-Pastor, Perakakis, Subramanya, Telles, & Vila, 2013; Courtney, Cohen, & van Dixhoorn, 2011);
- executive function and/or cognitive function (Thayer, Hansen, Saus-Rose, & Johnsen, 2009; Marcovitch et al., 2010);

- cognitive appraisal effects on the body (Luecken, Appelhans, Kraft, & Brown, 2006 ; Denson, Grish am, & Moulds, 2011).

Vagal Tone

A promising area of vagal tone research is in the ability to observe the dynamic interaction of physiological response in social interactions, particularly between a parent and child. Research looking at vagal tone of both parent and child engaged in interactions is robust (Williams & Woodruff-Borden, 2015; Suveg, Shaffer, & Davis, 2016; Smith, Woodhouse, Clark, & Skowron, 2016; Moore, 2009; Lunkenheimer et al., 2015; Gunning, Halligan,

& Murray, 2013; Feldman, Weller, Sirota, & Eidelman, 2002; Ferrer & Helm, 2013; Feldman, 2007a; Feldman, 2007b; Diamond, Fagundes, & Butterworth, 2012; Calkins, Smith, Gill, & Johnson, 1998). The volume of work in this area suggests a strong affiliation with the interbrain connection between parent and child, and illustrates the parent's role in co-regulating a child right from birth, or even prenatally. Research in this area is critical to self-regulation, demonstrating the initial foundations of the development of self-regulation from an evidence-based physiological measure.

Because of the statistical complexity of interpreting vagal tone data, many published reports require critical analysis to draw consistent conclusions, as different analysis methods can result in different interpretations of the same data (Lewis, Furman, McCool, & Porges, 2012). Publications often lack precision and accurate editing of artifact (electrical activity coming from places other than the brain, such as jaw clenching), and measures of vagal tone are often misinterpreted (Porges, 2007). While the need for such precision renders this measure inaccessible to many researchers, there are international guidelines

available for the quantification and accurate interpretation of vagal tone (Electrophysiology, 1996), as well as a very recent article that provides details on the practical aspects of using vagal tone in a clinical lab setting (Laborde, Mosley, & Thayer, 2017). Both of these are practical resources for advancing the quality and volume of upcoming research in this area.

The greater issue is that measures of vagal tone including HRV require relatively expensive equipment and considerable technical skill to implement. They are unwieldly or impossible to use in natural settings. Participants typically find the assess-ment process stressful. This impacts their state of psychophysio-logical arousal and can confound the measurement of the stress response. This is particularly true of children and vulnerable adults. As such, these measures are often too expensive, invasive, and technologically complex to use outside of research laboratories.

Other Physiological Measures

While the above categories of psychophysiological measurement emerged from the review of the literature, there are other measures relevant to self-regulation and/or the stress response as described in the following section.

Cortisol

Measuring cortisol levels can provide researchers with information about the stress system in mammals. The Hypothalamic–Pituitary–Adrenal (HPA) axis, part of the mammalian stress system connecting the limbic and cortical systems, releases hormones stimulating the production of cortisol, which enters all the cells of the body and brain. Its re-ceptors can mobilize energy for action and create memory for threats, but this wears on the immune system (Hostinar

& Gunnar, 2015). Cortisol levels follow a diurnal rhythm, but dysregulation of this pattern can cause internalizing and externalizing problems (Ursache, Noble, & Blair, 2015). The cortisol stress response is adaptable in the short term, but dysregulation occurs when the HPA axis is over-ac-tivated, resulting in allostatic overload shown by altered diurnal patterns of cortisol (Dich, Doan, & Evans, 2015). Cortisol can be measured via collection of overnight urine (Dich et al., 2015), hydrocellulose sponges (Ursache et al., 2015), or more often an oral saliva swab (Borelli, West, Weekes, & Crowley, 2014; Schonert-Reichl & Lawlor, 2010; Verner et al., 2010), making it accessible within a variety of familiar environments.

Skin Conductance

Electrodermal activity (EDA) is a means of measuring the electrical conductivity evident on the skin's surface, including fingertip sensors (Wilson, Lengua, Tininen-ko, Taylor, & Trancik, 2009), or facial skin temperature changes (Eum, Eom, Park, Cheong, & Sohn, 2014), where increased sweat gland hydration (fingertips) and blood flow (facial) are known to correlate with autonomic (sympathetic) nervous system activity.

Glucose Depletion

> Some areas of research use an analogy comparing self-regulation in mammals to a muscle, where fatigue occurs with use, requiring recovery (Muraven & Baumeister, 2000). Depletion of glucose levels can represent self-regulatory fatigue because stressors cause the body to expend glucose in the form of energy (Evans, Boggero, & Segerstrom, 2016). If self-regulation depends on depletable energy, some of this must be derived from glucose and there is much evidence that exercising self-control – which re-mains a separate and secondary construct to self-regulation
>
> – reduces glucose in the bloodstream and impairs later reg-ulatory ability (Gailliot, 2015).

Cortisol measurement has been used in research to look at moderating conditions of stress, such as socioeconom-ic status (Ursache et al., 2015), mindfulness (Schonert-Reichl & Lawlor, 2010), stress vulnerability (Jirikowic, Chen, Nash, Gendler, & Carmichael Olson, 2016), teacher burnout (Oberle & Schonert-Reichl, 2016), temperament and personality (Blair, Peters, & Granger, 2004), competitive pressure (Verner et al., 2010), and dyadic relationships like those between a parent and child (Borelli et al., 2014; Hatfield & Williford, 2016). As such, cortisol measurement is a well-validated indicator of a stress response. With self-regulation being couched in our fluctuating autonomic responses to threats or stressors in our environments (and their contribution to potential allostatic overload), cortisol may be a good measure contributing to our understanding of the physiological aspects of self-regulation.

While cortisol can be a primary physiological mediator of stress, however, there is no gold standard methodology of measuring allostatic overload, and in terms of self-regulation, this process may be more complex than stress itself – self-regulation may be a potential moderator (Dich et al., 2015). Cortisol measures can be either very invasive (if using blood) or moderately invasive (if using urine or a swab/sponge), but cortisol levels must be contextualized by both time of day (due to natural daily fluctuations) and baseline rates that vary from individual to individual. Analysis of cortisol is undertaken in a lab, which requires resources. Cortisol, however, can be collected in relatively natural settings rather than the lab only.

EDA measures can look at general sympathetic arous-al or skin response connected to specific stimuli, and has been shown to correlate positively with high arousal and threat-based distress, and negatively with externalizing problems and delay of gratification (Wilson et al., 2009). This method of data collection as it relates expressly to self-regulation, however, is sparse and lacking conclusive evidence.

There is some promise in self-regulation being associated with physiological changes in parasympathetic nervous system activity connected to the conservation of resources and to the visceral organs of the body, but there are limitations to using them as measures of the self-regulation framework, including: the reliance of these changes on specific self-control tasks as opposed to self-regulation; normative fluctuations in

blood glucose; inconsistent rates of glucose absorption; inconsistent performance on complex mental tasks that may improve following exercise (that is, decreased blood glucose); and the fact that comparative research in this area may not generalize to humans. Once again, the measurement of glucose is moderately invasive, but requires baseline levels, context of time of day, and lab-based analysis to create meaningful data, just as with cortisol measurement. This restricts the use of these measures to those with the technical resources to do such analyses.

Summary

Bio-physiological measurement of the stress response has been used and validated in clinical and laboratory research. There are three main challenges of using this form of assess-ment in Self-Reg research. First, many of the direct measures of the stress response require specialized equipment (for example, heart- or eye-tracking monitors) or interpretive processes (for example, lab analysis or contrasts to baseline states). There are promising developments towards accessible and affordable bio-metric devices, yet it remains unclear whether these devices are either sufficiently accurate or informative enough to help assess stress responses as part of a self-regulatory process. A second is-sue is that many of these measures are invasive and can be intim-idating for people. As such, the assessment may become a stress-or in and of itself and confound the information about stressors of interest. The third issue is the most challenging. Self-Reg is a dynamic process that is reflective and responsive to context.

Static measures of most biometric responses present only a snapshot of a response in time. Some measures can track psychophysiological processes over time (for example, fMRI, MRI, eye tracking, heart rate), but only heart rate measures can be used outside of the lab or for extensive periods of time. These measures are only of physiological response. Assessments of Self-Reg require careful analysis beyond the physiological to understand all five domains of the framework as a dynam-ic system: biological, emotion, cognitive, social, and prosocial. Bio-physiological measures offer Self-Reg researchers what may be a piece of that Self-Reg assessment puzzle.

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