More Than Just a Game: Tennis as a Means to an End

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Since the beginning of time, regular physical activity has been a central ingredient in the recipe for optimizing human mental and physical health. While COVID has turned the sports world upside down, a handful have not only survived, but thrived – and one of them is tennis.

The number of people playing tennis in the United States has held steady at between 17 and 18 million players for at least the past decade, but because it is one of the few sports where social distancing is possible, roughly 4 million new players entered the sport in 2020 – a 22% increase to 21.64 million[1]. The last time that tennis saw this degree of growth was when Billie Jean King squared off (and won) against Bobby Riggs in 1973.

Considering this appreciable influx of new players into the game in the context of the United States Tennis Association's (USTA's) goals:

1. Player **acquisition**
2. Player **engagement**
3. Player **retention**

the focus clearly now shifts to #2 and #3 – engagement and retention, which are particularly consequential for our new *young* players. Toward this end, in 2021 the sport's National Governing Body is relaunching their youth tennis brand, "Net Generation," with an overarching goal of promoting tennis as a vehicle for holistic youth development – particularly as only 1.6%, 1.0% and 2.3% of male junior players (female numbers are roughly equivalent), respectively, go on to play

NCAA Divisions I, II and III. Further, only a percentage of Division I athletes receive scholarships – not all full – with Division II athletes receiving substantively less – if anything at all[2, 3]. The percentage of male college players who go on to play pro are roughly .01%, and for the women, the number is .006 [2, 4].

For these highly talented individuals, players who demonstrate the extraordinary talent, discipline and grit to rise up through the competitive ranks – whether into the NCAA, the WTA or ATP – finding the required resources and support needed to compete on the collegiate or world stage is an all-consuming endeavor, but it's an issue that can be solved, starting with focal support by the USTA.

Reflecting more deeply on these numbers, and the rarity of any individual player either receiving a college scholarship or going on to make a living on the tour, ***leveraging tennis as a vehicle for holistic youth development is, by far, the highest purpose for our sport***. Tennis has the potential to alter multi-generational life trajectories – in ways many other sports don't – and has the added bonus of contributing to *longer and healthier life trajectories* – all which will be shared in the scientific story below[5].

And maybe, just maybe, changing the premise of the game – with a goal of *developing the whole human being* – may give rise to a new kind of junior player, who prioritizes tennis over other sport alternatives – because it's FUN! They are supported in this because their parents understand the unique developmental asset that tennis represents and frame the tennis experience as a means to an end for their child – rather than a low-odds scholarship opportunity.

All of this unfolded because the USTA invested in educating coaches to approach tennis instruction through a comprehensive developmental lens, experts in creating the kinds of on-court experiences that make hard work and learning feel like the "flow state" of fully engaged mental and physical play – catalyzing positive energy and intrinsic motivation for young players to make tennis their game for life[6].

And FUN, which is called "engagement" in the scientific literature, is the name of the game.

Fun is the #1 factor that motivates young people to come back for more - which, of course, bodes well for retention[7]. And who knows – perhaps this new crop of players, in it for *the joy of the tennis experience* – may alter demographic trends in the years and decades to come, possibly even increasing the presence of U.S. players competing – and winning – on the world stage – then sharing their stories and serving as inspirational role models for our up-and-coming juniors.

To achieve the overarching goal of the USTA, and to do it well, it will entail repositioning tennis as more than simply a game where one player wins and the other loses. Rather, we must tell the clear scientifically grounded story of ***tennis as a means to an end***[8, 9].

RE-BRANDING

The long-lens game for tennis, consistent with the research-based principles of positive youth development, starts with building skills and habits that optimize lifelong mental and physical health. *Because if we don't have our health, we don't have* ***anything***! On-court instruction time becomes an "*experiential learning lab*" where character, social-emotional skills, and adaptive

management of stress – qualities that are known to change multi-generational life trajectories – are fostered and fortified.

Childhood and adolescence are known "sensitive periods" in brain development characterized by a *high level of neurobiological malleability*, with openness to long-term habit formation that is unmatched throughout life[10]. The *outsized developmental impact of the early years* is an essential part of the tennis story of that must be told – as it is during this in life chapter that coach educators can have the most profound and lasting impact – for better – and for worse.

In committing to the central goal of helping players of all ages – though especially our juniors – fall in love with tennis by creating on-court environments that foster *rich engagement and retention and serve to develop the whole child*, the USTA, with requisite intentionality and leadership, can do a great deal to help young people across our country develop the mindset of *playing to learn*, rather than the simplistic and limiting goal of *learning to play*.

The USTA's 2021 re-launch of the Net Generation youth brand must be accompanied by a *redefinition of what the unique, open-skill sport of tennis has to offer*, over both the short- and long-term. Youth tennis must be promoted as an authentic and effective arena for *positive holistic youth development* – a vehicle capable of building foundational skills that undergird a healthy, productive, connected, engaged and meaningful life.

In business lexicon, tennis builds life skills and embeds preventative health behavior that yields a demonstrably *higher return on investment (ROI)* than either academic achievement or IQ – two of the most widely tracked outcomes for young people. Which begs the question: are cognitive

abilities and grades *really the right outcome metrics to track* to predict the kinds of characteristics that will help our young people thrive in the real world?

100 years of psychological research says – unequivocally – no!

A concept called the "25-75 Rule" validates that it is life skills and learned traits – particularly those rooted in character – that account for 75% of big life outcomes related to human achievement[11]. The fact that *only 25% of what's really important in the end* stems from an individual's cognitive abilities and school grades underscores the potential for sport to be *reconceptualized as a unique multi-modal educational context* in which powerful, lasting, life trajectory-altering learning can enhance the kinds of outcomes metrics that matter in the long game of life.

This is not to say that cognitive abilities and grades don't matter – they do – though not as much as we may think. With this said, student-athletes *also* tend to have better grades, higher rates of educational persistence and completion, lower rates of anxiety and depression, and for tennis in particular - lower rates of high-risk behavior relative to athletes in other sports, and higher rates of "healthy high achievers" (e.g. higher academic achievement, health behavior, mental wellness, and lower substance use, behavior problems) [12-17].

Moreover, due to the powerful medicinal-strength effect of exercise biochemistry, combined with emotion regulation skills learned on the court – tennis can help embed reliable lifelong habits and strategies for healthy stress management too[18-20].

And tools for managing life's peaks and valleys *is a gift that just keeps on giving*!

Science clearly shows that using "Mother Nature's Oxygen Mask" – time-tested, built-in tools to manage life's inevitable stress (exercise, sleep, nutrition, meditation, breathwork, situational awareness, growth mindset, visualization, laughter, gratitude, altruism, community engagement, skills to build and nurture high-quality relationships) – are now validated by cutting-edge biosocial research[21]. When used consistently, these behaviors and mindsets – grounded in common sense, and used in some way, shape or form since the beginning of time to survive, adapt and evolve as a human species – not only work, but pay *significant dividends* throughout life[21].

In particular, the three key ingredients ("The Power 3") in the recipe for optimal health and well-being – regular exercise nutrition, and sleep – are nothing short of *essential* building blocks for all else in life. These lifestyle choices, *organic and intuitive themes in any narrative about sport*, operate both individually and synergistically to support just about every life outcome measured in the scientific literature throughout the developmental course[22]!

Exercise biochemistry will be covered in detail below, and nutrition and sleep require their own separate airtime. Let's start with food – which is not just caloric fuel, where *hamburger = hot dog = salmon = avocado = Snickers bar = Big Mac*. No! When Hippocrates said: "Let food be thy medicine" (circa 400 BC), he was alluding to the gut-brain axis, which links the emotional and cognitive centers of the brain in an ongoing bi-directional communication stream with the intestines and immune system[23, 24].

Food IS medicine, and empty calories (ice cream) are "red light" foods, which are fine from time to time, but not every day – and certainly not several times a day! Apples are "green light" foods, high in fiber and low in sugar, and have minimal quantity limitations. Nutritional awareness

can be reinforced through tennis, and is a broader topic for our schools (vending machines containing "food" items with 20-syllable ingredients? Really? Are school nutrition policies set by the Centers for Disease Control holding up at a local level?), social services, and public health[25, 26].

The other major health pillar is sleep, which can be thought of as the body's master dial, which tweaks (or cranks!) levels of related dials (appetite, exercise quality) – all which synergistically contribute to health and wellness[27].

Poor quality or inadequate sleep slows metabolism (weight gain happens faster), makes us hungrier (lowers levels of a hormone called *ghrelin* which tells us when we're full. When ghrelin can't get the "STOP eating - you're full!" message to the brain of bad night's sleep, we *think* we're hungry when we're really not. On days like this it's a good idea NOT to home-office in the kitchen!), weakens the immune system's ability to fight off viruses (like COVID-19) and bacterial infection, and has major implications for brain health too.

During sleep, our neural night maintenance "clean-up crew" sweeps away cellular debris that's served its useful purpose, is no longer needed, and is now cluttering the path. This neural street sweeping is very important, as it clears the road for the signaling equipment that IS being used, to function as seamlessly and efficiently as possible[27, 28]. Sleep deprivation has major long-term implications for brain health as related to Alzheimer's Disease and dementia, and also for cardiovascular disease, the leading cause of death in the U.S.[29-33].

This is a long way of saying – *To be the best we can be, we must start with "The Power 3"* – a conversation easily had and reinforced at strategic times before, during or after on-court play.

Collectively, these learned wellness skills catalyze "upward spiral" biochemistry, a mood-elevating elixir produced in our own *in-house manufacturing facility* that includes the neuropeptide oxytocin ("the love hormone"), serotonin (feel-good neurotransmitter), dopamine (novelty and excitement) and endorphins (the brain's home-made opioids).

When we know what stress feels like inside our bodies (often it's felt in the chest, stomach, and other physical places that can serve as important clues) – and are equipped with built-in solutions – it feels empowering! Healthy stress management *protects us on the downside* (combats fatigue, brain fog, and poor mood) and *amplifies positive outcomes on the upside* (creativity, innovation, bold new ideas!), embedding a sense of confidence and competence around managing what Shakespeare termed the "slings and arrows" that are endemic to life.

If stress is left unchecked and becomes a chronic state of affairs – powerful inflammatory stress biochemistry runs amok in the mind-body system – like a floored gas pedal in a car that never lets up. If one recognizes the signs of stress, the first-line prescription is the *Oxygen Mask – Power 3 Combo*, which produces offsetting biochemistry that can neutralize that of the stress response[21].

However, if this doesn't happen, either the engine burns out (brain / body / chronic fatigue), or worse, there's a big giant crash (mental illness/chronic disease). Unrelenting chronic stress biochemistry can and does impact the function of our organ systems, the brain, metabolic health and immunity – ***but*** –employing the things we know work, as discussed above, not only increase lifespan – but "healthspan too" [34-36]!

Hopefully this provides adequate incentive NOT to feel guilty about prioritizing time for self-care! Guilt is an emotion frequently associated with taking the time we need to slow down, breathe, and be at home in our own bodies – rather than the endless pursuit of wrapping up the mental checklist that never gets completed. The checklist can wait – our lifespan and healthspan depend on it! These precious, restorative windows of time, ones that start at the top, but are gradually reprioritized to the bottom of the list – demand and deserve respect. In this way, we can show up as our best selves in the world, firing on all cylinders!

Disciplined self-care is all about developing personalized core competencies in "getting our own oxygen masks on first", in order to, in the words of Katie Reed "*give the best of you, rather than what's left of you*!" Because we're all different, and what works for one person doesn't work for another, it's important to know what works best for us – as it's these strategies that we're more likely to use – especially at strategic (stressful!) times when taking a step back can go a very long way toward maintaining a molehill that could, in a flash, turn into a mountain.

Prioritizing wellness is important for all human beings, but specific to coaches and other adults in children's lives, the following quote by Robert Fulghum says it all: "*Don't worry that children aren't listening to you, worry that they are always watching you*!".

Mirror neurons, while not the sole mechanism involved in children modeling adult behavior, are one important source[37, 38]. Children tend to imitate, or "model" the behavior of key adults in their lives – so take good care of yourself, *preach what you practice*, and learning will embed more effectively than it can when communicating with only words[39, 40].

In closing, the scientific evidence in support of lifelong disciplined wellness practices as the most effective form of preventative health – could not be any clearer.

EVERYONE benefits from "The Power 3" (exercise, nutrition, sleep) as a rule, and this core content, with personalized self-care add-on's, supports us all – coaches, athletes, parents and everyone else in our various relational systems – *in myriad ways across all contexts*.[21, 22] What bears spelling out in more detail is the scientific story of humans as interconnected at the energy level, how emotions are contagious, and *how the emotions of one affect the emotions of all*[19, 41, 42].

RELATIONAL DYNAMIC SYSTEMS

When the biochemical dividends of *upward spiral* biochemistry accrue in the *mind-body energy store of the individual*, a molecular-level *pay-it-forward ripple effect* accrues to the *collective mind-body energy store of the larger group too*. This might sound complicated, but it's not, and when we pay close attention and know what to look for – we can actually *feel* emotion contagion unfolding in real-time.

Human beings operate not in isolation, rather in *dynamic systems of relationships* where energy and emotions infuse into the emotional climate of the whole. This process can subtly (and sometimes not-so-subtly) shift the emotional biochemistry of the group, as neurotransmitters, hormones and gene expression patterns are biologic (under-the-skin) messengers of what's happening – or rather *what's perceived to be happening* through our own personalized filter (a synthesis of genetics and life experience) – in the outside world [41-43].

An intuitive way for tennis players to understand this interactive emotional exchange comes in the form of doubles play. Think about the difference between committing an embarrassingly bad error – on a really important point - and having Supportive Partner A (*No worries – it was a great idea! You'll get it next time!*) versus Judgmental Partner B who verbally throws you under the bus – right there in front of everyone – and loudly (!!) (*Seriously?!? My grandmother could have made that shot!*).

Now imagine you're the partner of Player A, and next, Player B. How do these two scenarios make you FEEL? Emotions are comprised of molecules, and because *what's real in the mind is real in the body* – this means that there's a downstream biological effect of the feelings we experience in everyday life.

In our doubles story, two distinct biochemical cocktails emerge from each of these dynamic human energy exchanges – analogous to an ongoing *molecular + quantum* energy rally that's happening all around us, though not visible to the naked eye – as it's happening *under the skin* and not in plain view with two rackets and a ball! The response of Partner A helps *neutralize the stress response* in their partner, which initiates the *mental windshield wiper* to clear the slate for the next point, catalyzes a growth mindset.

While this positive *player* ⇔ *player* dynamic *may* serve to capture victory from the jaws of defeat, it *will* increase the odds of a positive outcome in a directional manner. And either way, win or lose, this supportive human dynamic *provides positive* fuel for the friendship, and wires another positive tennis experience into a young player's mind. It's a WIN-WIN for the team!

Partner B's reaction, on the other hand, *amplifies the stress response* (unless the partner has the mental toughness to *"be like a duck"* and let it roll off their back – another skill that is readily developed through tennis!), increasing the chance of a rapid slide down a dark, slippery, twisty, cognitive rabbit hole ("*What on earth am I even **doing** out here? Is tennis really my sport?!?*"), which then up's the odds for a *mind-numbing series of careless errors* that accelerate the path toward loss.

The sinking feeling of snatching defeat from the jaws of victory. NOT FUN!!!

And let's be clear that this is *not the good kind of loss* that spawns growth, as embodied in the Latin definition of the word "competition" – "competere", which means "To Strive Together", where one player wins and one loses, but there's a larger shared goal of bringing one's inner warrior to the court in order to raise the level of play for both – whatever the outcome[44]!

Rather – this is the *bad kind of loss* that sits in a dank, still, cold place, biochemically lodged at strategic pit stops across the mind-brain-gut axis (brain fog, anxiety, depression, nausea) – providing the felt sense that a dark cloud landed on your head and won't go away. Impulsivity and anger serve neither the individual nor the team, nor performance, nor the mental well-being of either player – nor the health of the friendship. Unmotivating and uninspiring to the core. It's a LOSE-LOSE for the team!

The broader point is that the emotional energy of one person in any system of relationships affects the emotional energy of the whole, which has implications for coaches both in one-on-one and group settings.

Tone *is arguably more important* than the words themselves, and it's vital to know that the energy sent out by one – especially a trusted and respected coach, with whom there is an inherent power differential, whose message is likely to embed at a deeper and stickier level – ripples out to all – like throwing a stone in the middle of a still pond[45-48]. Tone takes the fast track to the listener's amygdala (the brain's "emotional smoke detector") registering at an emotional level before our prefrontal cortex (the brain's "air traffic controller" – executive function, attention and self-regulation) has a chance to process the event as a package and make sense of it[46].

Positive tone is the vehicle that most effectively transports the intended *passenger (life lessons)* to long-term memory in a way that helps make learning stick. Constructive emotion energy exchange spawns growth in a young person, and amplifies the potential for a spark to take hold in the coach⇔ player ⇔ team relationship, one that can go on to light the fire of engagement, learning and growth.

However negatively-toned communication, especially when stress is in the air and emotions are running high, dumps a big bucket of cold water on the spark of possibility that exists in the coach ⇔ player ⇔ team relationship, fizzling the spark, and with it drowning out the opportunity to deliver the kind of life-changing-teachable-moment-lesson that coaches live for.

In other words, it's partly the *what*, but even more so the *how* – that can make the biggest difference in communication. Harsh words affect player engagement (*I cannot **wait** to get out of here!*), learning (*consider your **own** attentional level when someone is barking **at** you, and not talking **to** you.*), and the general desire to get back on the court the next day.

Lack of emotional awareness on the part of a coach who doesn't recognize they've slipped into an unconstructive, and potentially even damaging emotional jungle (sarcasm, yelling, discrimination of any kind, targeted verbal abuse) – and unequipped with built-in strategies to find their way out – not only paves a path for player disengagement, but can impact their self-efficacy (belief in self, coping skills), sense of belonging (can I safely be myself in this place, with this coach?), and identity (culture, story, and sense of self).

And of course – the *least important* outcome of them all, which also happens to be the one of *greatest interest* to the vast majority – negativity crushes performance too – across the whole relational dynamic system!

EMOTION REGULATION

Building neural musculature around self-regulation is essential, and when coaches have basic training in emotional intelligence skills, they can use on-court time strategically to bolster this important life skill in their players – *just like teaching a forehand.*

Most often, children learn emotion management skills by watching their parents, and because most parents have not been trained in developing these skills – it's a rather haphazard environment for learning. While it's been historically rare that the subject of emotions shows up in as a topic in school – this is quickly changing – and not only in the U.S.[49-51]. Practical, user-friendly emotion skill-building programs are making their way into classrooms and workplaces across the country and world – with tangible and measurable results – a body of work that must make its way into youth sport too[50, 52-55].

Emotional intelligence is often misunderstood to be a set of "soft" (insinuation: unimportant) skills that don't matter that much in life.

However, just the opposite is true. Emotions, when understood and properly leveraged, hold legitimate "data". Because of this, emotional climates matter a lot – for metrics related to motivation, behavior, satisfaction, employee turnover, performance metrics, mental health – and because mental and physical well-being are two sides of the same molecular coin – physical health too[19, 41, 56]!

Emotion regulation can be learned early on through tennis (*something Partner B, in the previous section, clearly needs to work on!*), by building, and through play-based repetition, fortifying neural wiring patterns that improve situational awareness that serve as built-in yellow lights (*breathe…*) and importantly – red lights (*Don't say another word till you cool down!*).

Applying key elements of Mother Nature's Oxygen Mask at strategic times (breath, awareness, adaptive mindset) provides a space in which an individual can see the fork in the emotional road coming, and make an intentional decision *to act, rather than react* – yielding a far greater return on investment (Positive ROI with a capital "P") than that conferred by impulsivity (Negative ROI with a capital "N"!).

When an individual practices the mental muscle to "pause, reflect and label" in high-stress situations, they fortify the neural connectivity patterns of emotionally intelligent stress management, which convergent disciplines across the biopsychosocial sciences reveal as life skills

that reside squarely in the aforementioned 75% category that matter more in life than academic achievement and IQ[19].

The capacity of a coach to regulate their own emotions rests upon maintaining a reasonably full battery, putting the importance of self-care squarely into the spotlight. Coaching can be exhausting – especially when out on a hot court, hour after hour in the blasting sun, humidity high, wind blowing – striving to maintain positivity to make the on-court experience a good one. Wellness inputs are cumulative at a biochemical level, and to have adequate bandwidth, coaches must "*get their own oxygen mask on first.*"

With adequate energy in the mind-body tank and requisite emotion skills, coaches can play a powerful role in bringing "The Power 3", and the menu of possibilities for Mother Nature's Oxygen Mask directly into the front row for their players – helping them create their own personalized recipe of add-on's (meditation, mindfulness, mindset) that support the core (exercise, nutrition, sleep) – collectively strengthening capacity for emotion regulation, and all during a developmental chapter when neural plasticity is at his highest and learning is most likely to stick.

Indeed, tennis can be a powerful – and for some children, particularly those at-risk by virtue of racism, discrimination, or poverty – ***the*** most powerful lever they will ever have to write their own stories and live their way into lives they choose and deserve.

"Between stimulus and response there is a space. In that space is our power to choose our response. In our response lies our growth and our freedom." – Viktor Frankl [57]

THE SCIENCE: Mental and Physical Health are Two Sides of the Same Coin

A good life – one that is full, relationally connected, meaningful and productive – starts with good mental and physical health. And science conveys a clear story that mental and physical health are, at a molecular level, two sides of the same coin[56, 58]. This is because the very same inflammatory markers and neurotransmitters that play a role in physical illness – particularly chronic disease (obesity, cardiovascular disease, Type-2 Diabetes) – also play a role in mental illness (depression, anxiety, and other psychiatric disorders)[59].

MENTAL HEALTH

This molecular overlap between mental and physical health, given the positive mind-body impact of *upward spiral exercise biochemistry*, has important implications for not only de-stigmatization of mental health issues, but also, on a proactive note – for non-pharmaceutical treatment[20, 60]. A wide and deep body of research shows exercise as a powerful avenue of treatment for anxiety and depression – the two leading categories of mental unwellness in the child and adolescent population today – with prevalence rates in each area continuing to rise[61].

Many coaches want to help, but don't know what to look for, nor what to do if there is a clear problem[62]. Despite good intentions and the desire to help, they were not trained as psychologists, psychiatrists or social workers, hence are not formally equipped with insight nor an action plan for dealing with player mental health issues in real life.

Resources are being developed to meet this need, both for athletes and coaches, including the piloting of targeted programming developed by medical experts for coaches of all kinds[63, 64]. The

new program, called “Mental Wellness for Coaches”, covers: Mental health 101 (common signs and symptoms, what to look for), Building resiliency (strategies and best practices in communication with athletes and peers), Stress management (tips and tools), and Self-care for coaches (as discussed above) [63, 64].

Suicide rates continue to rise across age groups in our young people – most recently becoming the second leading cause of death for all children and adolescents between the age of 10 and 17. Collectively, this underscores the vital nature of having as many sets of sentient, aware and informed adult eyes on our youth, and also – the importance of intentionality in teaching wellness-promoting strategies to manage the high levels of stress endemic to the teenage years – that which has been amplified by COVID-related issues – especially for those living on the margins whose lives are marked by other vulnerabilities[65].

Mental unwellness is underdiagnosed, stigmatizing, and treatment is capacity constrained at a system level (though progress is evident in telehealth)[66]. These larger issues are relevant to our discussion, as within this slow-moving process of building the necessary systems to support mental wellness, it’s important to note that tennis can play a role in both prevention and intervention[67, 68].

The mind-body synergy of on-court movement, activating an endlessly complex series of proprioceptive systems in order to move one’s feet, set up, watch the ball, make last-minute micro-adjustments, and hit it right in middle of the sweet spot – can be transportive – taking one’s mind from the “then” to the “now”. And the physiological part of it (exercise biochemistry) is only half of the story. Equally as powerful is the mood-enhancing brain chemistry of social interaction (*upward spiral*) that unfolds walking onto the court, during changeovers, and when play is done.

This basic formula – *dynamic open-skill mind-body exercise + human conversation = improved sense of physiological and psychological well-being after play* – is why tennis tops the list of sports that extend lifespan. While the Copenhagen Heart Study didn't examine mental wellness specifically, it's not hard to imagine that tennis stands out in this category too – because of the very same formula[5].

PHYSICAL HEALTH

Regular physical activity is the top treatment for obesity, a health condition that affects 42.4% of U.S. adults and 18.5% of children age 2-19, and exponentially increases the odds of developing a chronic illness[69, 70]. Per the Centers for Disease Control, 90% of our $17.6 trillion healthcare expenditures in the U.S. are spent on chronic physical and mental illnesses – both which can be *partially or entirely prevented* with healthy lifestyle choices and behavior[71].

The obesity epidemic continues to exact an extraordinary cost globally, but in particular here in the U.S. – home to 4% of the world population and 18% of the world's body mass[72]. The toll on our healthcare system, societal productivity, and quality of life at the individual level is, in a word – unsustainable. And regular physical activity is an *essential* part of the solution.

Beyond boosting metabolism, strengthening the immune system, and oxygenating the brain, exercise catalyzes a molecular-level chain reaction that can initiate a "virtuous cycle" of health-promoting behavior choices[22] – improving behavior choices and mindsets that set the stage for wellness and optimal performance – such as:

- nutrition[24]

- sleep[28]
- positive mindset[73, 74]
- high-quality relationships[75, 76]

The adaptive chain reaction stimulated by exercise biochemistry elevates possibility for all outcomes in life that rest upon a foundation of mental and physical well-being – which is pretty much everything!

And, importantly – many tennis coaches have a natural tendency to seek just this kind of information out, as in general, tweaking performance-relevant lifestyle choices is endemic to the tennis psyche. Few, if any sports provide a better window into the complex and captivating question of mind-body wellness more than tennis – which situates coaches in a position to educate and be a force for health promotion in their players lives early on when it matters most.

THE SCIENCE: Learning and Development

The general context of youth sport, though tennis in particular ways given the unique *physical, mental, and emotional (multi-sensory) requirements for play*, is a powerful arena for the development of many essential skills and habits – though of particular importance in the long game of life are character virtues[77] such as:

- integrity
- honor
- respect
- empathy

- fairness
- teamwork

Tennis – optimally played under the aegis of character – has unique multi-modal qualities that draw upon a more comprehensive set of capacities than do many other sports[78, 79].

One possibility is that the demands of open skill sports (physical, cognitive, emotional), tennis in its own unique way, may promote *early neural network connectivity* that supports emotion regulation, as well as other skills that can nurture the development of character virtues as outlined above[18]. Further details can be found below in "Three Major Networks", but this may be a question worth exploring through the lens of neuroscience.

For example, recognizing negative emotion (anger, hostility, jealousy) before it is unleashed onto another – to the detriment of both parties – and having strategies to manage effectively, in real-time, may just provide the "*power of the pause*" needed to *act, rather than react*.

Showing up with *integrity rather than dishonesty*, *empathy rather than judgment*, and being the kind of person who doesn't need a reminder that "*There's no "I" in TEAM!!*" – are not traits we are born with. Like all else, building these skills take practice – and practice requires building new connectivity patterns in the brain – something that doesn't happen overnight. But rest assured, it DOES happen – *because what we repeat grows stronger* – that's how we are wired as human beings.

A process called myelination amplifies electrical signal speed in the brain for neural pathways that are used most, and by this basic neurobiological mechanism, over time, what we

practice become the automated default route (see "The Three Major Networks" below for more detail.) And because *our nurture (the environments we're in) shapes our nature (DNA)* through the biologic mechanism of *epigenetics* – 24/7, 365 days a year – this means there's always the opportunity to learn and grow across life – which means that indeed you *can teach* an old dog new tricks!

But to reinforce – *the early years are the most important*!!!

Character, just like everything else in the brain and body, must be thought of as a "muscle" that is developed with intentional practice, practice – then more practice! It starts with developing a character lexicon and giving students the vocabulary to link words with concepts via real-time lessons on the experiential classroom that is the court. For example:

- *Coach: Boy, that player had real **integrity**! He could have called the shot out – it was a big point in a tight match and the ball fuzz barely caught the back part of the line. But he played **fair** – and I **respect** that!*
- *Player: What does the word "**integrity**" mean?*
- *Coach: Integrity means acting with **honesty** and strong **moral** principles. Playing fair and doing what you say you are going to do – big things that matter not only in tennis, but in life. Can you think of some of the ways integrity might matter off the court?*

Attaching *character-based language to relevant real-world concepts*, in the rich open skill learning environment of tennis, where activation of distinct yet synergistic (multi-modal) neural

pathways in the brain and body embeds new experience in a powerful and lasting manner may – for our junior players – comprise some of their most *memorable and powerful educational experiences* across life. Moreover, it's important to underscore here again that these kinds of life lessons, particularly for our marginalized youth, can make the difference between staying in the societal system, *learning and earning*, and living the lives they dream of.

Many athletes report that it was the life skills they learned through their sport – and not the knowledge they learned in school – that paid off when finding a job. Of particular significance, sometimes in life it requires only one lucky break – finding the right job with the right supportive people – who see potential, take a leap of faith, and offer a chance.

While a CV provides a list of an individuals' accomplishments and experiences, in the end, employers are hiring a person – which makes the way in which that person shows up in stress-filled-touch-and-go situations, both solo and interacting with others – very important. This one chance can be just the foothold a young person needs to break the cycle of poverty, family dysfunction, or household adversity – changing the story not only for the individual, but also for generations to come.

Brains wired for a process-orientation toward growth and mastery, with the grit and discipline to persevere when the going gets tough, social-emotional skills to manage relationships, and the character virtues to show up in a way that serves the team – are precisely the skills employers want and need – arguably more so than content knowledge. And if specific expertise *is* a job requirement, this is something ***intrinsically motivated, process-oriented, gritty and disciplined***

tennis players can lean into and learn – just like setting one's training schedule for a big tournament that's months down the road.

Anything is possible with the right attitude, a strong work ethic and character virtues to match, and relational skills that make one's presence feel not like a linear addition (1+1=2), but rather, one that's exponential (1+1=3…or more!).

Before we discuss how the open skill sport of tennis builds certain kinds of brains, let's talk about how learning happens, and why some ways of learning are better than others.

MULTI-MODAL LEARNING AND FUN

Imagine that you're studying for a challenging test. To prepare, you open your book and do a passive read through of the exam material. Unless you're an extraordinarily gifted reader, high retention is unlikely right off the bat! But reading is just the first step, as you know your score will be higher if you recruit other modalities to *learn the same material in a different way*.

You highlight pertinent information and *annotate*, putting a pen to paper and writing meaningful notes in the margins. You draw a picture or conceptual figure that holds the *feel* of the test material, then pull out some magic markers and *color* it in. You *recite* the material out loud, pretending you're teaching a group of your peers. Then, you take it *out on a walk*, turning it over in your mind, *vocalizing* key words, and perhaps – if you feel really creative – even *making a song* out of it.

Embedding new knowledge with synergistic modalities: in this case *reading, writing, artistic creativity, speech, and song* – all amplified by the brain-fueling power of *exercise biochemistry* – creates connections to this new content using several wires in the brain, rather than just one[80-82].

And just for fun, imagine that while out walking, solo in the neighborhood, singing a goofy song about test material, a reflective chuckle bursts spontaneously forth (is anyone watching me??), lodging in your mind, and morphing into full-blown, unbridled laughter – the kind where your eyes crinkle up *(which activates a distinct set of neural pathways than the polite, mouth-muscle-activated obligatory social smile – and with it, distinct stress-reducing biochemistry[83]).* You just can't help yourself! And while you hope no one sees you, you can't stop – and further – you don't want to, as it feels GOOD to laugh, especially after sitting in a chair studying for the past two hours!

Just thinking about laughter feels good – try it! Visualize a moment when you experienced gut-busting laughter, the kind that made tears roll down your cheeks. *Really take it in…breathe it in and FEEL it*.

Why does a joyful memory feel so good, and how is it easy to recall that specific memory? Because laughter recruits our emotional circuitry in a very direct way, bringing the specific memory into sharper view in the mind's eye and also the body – because the memory was embedded in the context of the *upward spiral* brain chemistry of laughter. This is the basis for why positive emotional climates – especially those that include laughter – create the conditions for learning that lasts[84-86]!

"Multi-modal learning", as it's termed in the field of Mind, Brain and Education science, fosters the type of "deep learning" that lasts. Which stands in sharp contrast to the kind of learning that seems to fall out of the brain the moment an exam is over!

And while sport – in all of its forms – represents different types of "multi-modal learning" – tennis is special given the extraordinary mind-body demands placed on the individual to engage in on-court play[18, 78, 79]. Coaches can draw upon this powerful multi-level sensory dynamic to educate athletes on the courts, fields, arenas and rinks that are their classrooms. Learning by using multiple modalities, all while having ***fun***, makes new knowledge stickier in the brain – and also fuels the intrinsic motivation that makes kids want to come back for more the next day!

Focus Follows Fun[87], and when emotionally intelligent coaches of character create engaging context, and model the very attributes they hope their players will learn, it is evident why athletics is one of the oldest and best-known venues to teach skills, mindsets, and attitudes that foster positive long-term outcomes for young people.

All discussed above aligns with the scientific literature on emotions as strongest neurobiological wire to experience of them all. "*We are feeling creatures that think, not thinking creatures that feel*", in the words of neuroscientist Antonio Damasio.

Emotions are our most elemental connective tissue as human beings! When new learning embeds in a state of high emotion, the data has greater salience (it's stickier in the brain), which means that new material is likelier to make the full journey to long-term memory – and stay there[88,

[89]. Importantly – the stickiness of emotion-laden experience works both to the upside – and also to the downside.

Positive emotional climates can strengthen learning and intrinsic motivation, as discussed earlier, though the same basic neurobiological mechanism operates on the negative side of the ledger – especially as related to trauma. The durability of the emotional wire can create automated mind-body connections to a memory of adversity that that happened years or even decades ago – most or all of which below conscious awareness (post-traumatic stress disorder), where any triggering event or simply a thought catalyzing the "fight, flight or freeze" response[90].

Given that nature is shaped by nurture, it is possible to disrupt these so-called "neural shadows" and for "post-traumatic growth" to unfold throughout development – as we know science tells an optimistic story of what *can* happen when the context is right for a young person[91]. However, just as positive mindsets and thought processes are embedded most deeply and substantively in the early years, the same is true with trauma and adversity[90]. This is why, as will be discussed below, the first and foremost non-negotiable so that coaches may optimize the development of the whole child through tennis – *is* ***Safety First***[92]!

Leveraging the captivating, multi-modal, lifetime sport of tennis to embed practical knowledge that transfers immediately to real life, fortifying wellness-promoting behavior into habit, and teaching valuable emotion regulation skills that pay dividends across sectors – that is the goal for our juniors. But let's take this a step further, and consider how tennis might be a unique vehicle for building the kinds of adaptive, flexible, creative brains that our 21st century world will need?

Up next: brain development, and how the neural connectivity patterns built through open skill tennis play, may just have much broader ramifications on the long-term journey through life.

BUILDING FLEXIBLE, ADAPTIVE, AND CREATIVE BRAINS

Education is fundamentally about preparing our youth for an unknown journey through school, career, and life. And schooling should, at its very best, build diverse and complementary mental processes in young people – *in a way that nurtures each student's unique nature*. Individual differences are *the rule, not the exception* and *development is non-linear and jagged*[93]! We are all snowflakes – no one person is exactly like the other, and no two developmental paths are exactly the same.

The long game for education – both in and outside of school – is to build the kinds of brains equipped to engage in imaginative, thoughtful prediction about the future, are flexible and adaptive in a world that is changing by the day and are wired with relationship building skills that can strengthen teams and bolster collaborative problem solving – both to avert catastrophe and amplify innovation!

Moreover, at the most basic level, we must capitalize on the early developmental years to build the kinds of human beings that can engage in perspective sharing – in their personal relationships – and more broadly, to play a role in de-calcifying long-standing, historically intractable social justice issues around race, poverty, and discrimination[94-96].

Broadly speaking, youth sport is a vastly underutilized context in this regard – a natural arena to integrate key themes of social justice into youth-facing programs thoughtfully designed to

foster holistic development of all children – creating human ⇔ human relationships and authentic communication pathways that may be more effectively accomplished earlier in life[96-102]. When we can see one another, listen, seek to understand, and come together as a community of diverse human beings in support of the greater good – *we are all better for it*.

Human brains integrate new knowledge – about skills, relationships, perspective and the events of daily life – into that which has already been learned. This personalized body of information forms a "constructive developmental web", continually adding in bits of data that are relevant and helpful – providing humans with the ability to develop complex skills other mammals cannot[103]. This is why, especially during the most malleable years in life, it is vital to **intentionally develop and strengthen the connectivity patterns** that build just these kinds of perspective-taking, critical thinking and emotional intelligence skills – the ones that win the game, the set, and the match – in life!

Science tells us that there are specific ways to build the kinds of brains that will thrive in the 21st century. Our educational system, in its current form, is simply not set up to do this[104].

The game of tennis, however, is set up to do exactly this. And here's why.

THE THREE MAJOR NETWORKS

Neuroscience research reveals three major networks in the brain. First, the **Executive Control Network** (ECN - ON when our attention is directed OUTWARD, filtering external distractions to focus on a task); second, the **Default Mode Network** (DMN - ON when our focus is directed INWARD – reflecting, creating, imagining and "connecting the dots"), and third, the

Salience Network (SN - ON when deciding how and when to *toggle between our inside and outside worlds* – depending on what's relevant for each unique individual)[10].

What's important here is that our brains are at their most *efficient and effective* when there's constant "*cross-talk*" between our inner and outer worlds, each one informing, enriching and shaping the other. This means that just because we're immersed in our heads when the world is going on around us, *it doesn't mean there's nothing going on*! This is summed up in the title of a classic paper by neuroscientist Dr. Mary Helen Immordino-Yang: "Rest is Not Idleness."

It is these dynamic patterns of neural connectivity, active when our externally focused networks are OFF, that give rise to the big *"aha" moments* each and every one of us has experienced in life – when ideas pop into our heads, like giant randomly-timed lightbulbs – connecting disparate dots that have been sitting on our mental whiteboards for days, weeks, months – or even years. All of a sudden it all just makes sense!

How does this happen?

Our brains are a sophisticated set of neural interconnections, functioning at their best when the Salience Network is frequently and organically *synergizing and streamlining cross-talk* between the Executive Control and Default Mode networks, synthesizing relevant streams of both internal and external data to process, reflect, and decide on the next indicated action.

Each choice we make from the data the ECN and DMN are sifting through is rarely spelled out in black and white. Most often, decisions – the good ones – *are a particular shade of gray*, and

are based on judgment calls, prediction skills, empathy, and sound negotiation capabilities employed in an effort to land on the right solution for the greatest number of people.

The inner voice that bubbles up from the reflective space in which our brains are seemingly tuned to the inside – but also toggling information from the outside – both adds a stream of data to the decision-making process, and also **shapes how we make meaning** of the things that happen to us. And meaning making matters – a lot[105]!

Here's why.

MEANING MAKING AND WHY IT'S IMPORTANT

Our *perceptions* of the world around us integrate into our mind-body system through a thoroughly personalized lens – a combination of our biology and previous life experiences – making "objective reality" whatever we deem it to be[106].

This is important because as we recall *nurture shapes nature*, which means that *what's real to us – the reality that exists when viewing a matter through our own personalized lens – shapes how our genes are read and expressed, which changes our biochemistry, which makes our perceived reality – real at a molecular level in the body too.* This is all to say that, meaning making – *how we choose to see an event* – shapes not only our perspective, but our health too[106-108].

Was the extraordinary challenge – where failure was the outcome – really a failure? Or was it a great gift? The answer: it's both! *It all depends on our view*, which over time informs our powerful inner voice – the one that shapes the stories we believe about **who we are** and **what we**

are capable of in the world[109]. These very stories – our beliefs about **what is possible for us** – can provide the fuel for far-out dreams to manifest in real life[73].

What we know from science is when robust neural connectivity patterns – regular dialogue between the networks facing both inward and out – are established early in life, they form the foundation for other skills – like emotion regulation, reflective thought and process-oriented learning – to take hold[110].

New patterns of behavior and thought feel clunky and cumbersome at first, because the neural wiring is slow and efficient (think dial-up modem). However, as these same patterns are repeated – activating the same neural pathways over and over – the brain thinks "Pay attention! Something important is going on!".

It then deploys a fatty substance called *myelin*, which coats and insulates the neuron, minimizing electrical signal leakage, and upgrading the sketchy dial-up modem transmission to lightning-fast internet[111]. Following the logic of evolution – if this signaling pattern is important enough to continuously repeat – the signal had better be fast – for purposes of survival!

Myelination is how habits are formed – and this happens only in one way – by repetition, repetition, repetition. Over time, the most used signaling pathways take what was once a slow, bumpy country road, and turn it into a gleaming 8-lane neural superhighway!

This is all to say that *what gets repeated is what sticks* – so it's important to repeat the things that will help, rather than harm. And in this process – meaning making matters *a lot*. When we inculcate adaptive patterns of thinking and being in the world through growth mindset and

emotion management skills that support healthy development across time, we are giving our young people a big head-start in life.

How can we build the kind of brains that give rise to flexible, adaptive, relational and dynamic neural networks that equip our young people for the challenges of the 21st century?

THE TENNIS BRAIN

The "open-skill" sport of tennis, with its dynamic, externally paced, constantly changing nature is *chock full of inward- and outward-facing neural network crosstalk*[18]!

Think about playing out a point, and the large number of discrete yet interconnected calculations the brain must make in order to anticipate where the ball might land, how it will bounce once it gets there (depending on the surface and quality of the court), then leveraging complex proprioceptive and spatial skills not only just to hit it – but hit it in a very specific place where your opponent (who you are tracking with your "Spidey Sense" all along – while simultaneously watching the ball) happens not to be. That's a *whole lot of inward- and outward-facing neural cross-talk* in just one short point, which on average, in tennis, lasts less than 10 seconds[79].

Then during the 20-seconds between points, a player must process multiple streams of information – emotion (*the court was wide open, how did I possibly miss*?!? *Breathe…settle…reset*!), physical (*aggressive feet would have helped*!), and intellectual (*I'm down a set and a half, but my energy battery is full – and my opponents is not – maybe I'll try a few dropshot-lob combos and see what happens*) – and that's just a start! There is SO MUCH going on, all the time, all which is

orchestrated by the brain. It's not over till it's over, and there's always the opportunity to come back – even when down 6-0, 5-0, 40-Love.

Talk about neurobiological interval training!! See the table below for a brief overview of how specific tennis skills may give rise to particular developmental assets for young players.

Tennis Skill	Developmental Asset
Navigating play, between-point breaks, weather conditions, mind-body preparedness (nutrition, sleep, stress), and opponent / partner social dynamics to bring best human self and best athletic competitor to match	Wiring into young brain emotion regulation / inhibitory control = major life asset. Habitual use of "The Power of the Pause" has implications for social relationships, school, work, play – basically everything in life!
Mind-body integration (proprioception, spatial skills, cognition, emotion) required to move to ball, make contact, then place it in a specific location calls for constant micro and macro-level recalibration of the entire physiologic system	Wires rich cross-network connectivity between executive control and default mode network, which supports inhibitory control, executive function, cognitive flexibility, creativity, may develop brains wired to skate to "where the puck is going to be."
Learning to play and developing mastery is an evolving process of 2 steps forward, one step back – leaning into stress and learning from failure to grow.	Learning as a journey – in school and in life – becomes embedded in neural wiring as general process-orientation, with built-in expectation of failure and loss as a pre-requisite for growth
2-4 players are spread out across a tennis court.	Lower risk of injury vs contact sports & others.
Scoring (player is never safe – open ended stress test!), can be up 6-0, 5-0 (40-love) and still lose!	A project or job is never over till over – requires concerted focus till the very end – constant strategizing and adaptation.
No clock – play ends when match is over – which can be many minutes or many hours!	Grit, discipline, perseverance – constant reset required – one point is all required to change momentum – adaptive mindset for life.
No refs. Players call their own lines, scores, and make in-the-moment judgment calls.	Character muscle-building opportunities abound!
Player is on their own – no coaching, no time-outs and no subs.	Builds self-efficacy, growth mindset, stress-management, confidence, competence.
"Open skill" sports (dynamically changing, unpredictable, externally paced) – tennis, basketball, squash	Executive function, cognitive flexibility, inhibitory control, temporal processing speed[112, 113]

In short, the cognitive load required by tennis fires up the three major networks – each with its own unique set of attributes – holding the kind of dynamic back-and-forth conversation that draws on comprehensive elements of our neural circuitry[18, 112, 114]. Indeed, the pattern of cross-network conversation required by on-court play is essential for building the very skills required to learn, grow, and develop a sense of mastery in the sport!

Imagine playing a match on a windy day as you mindfully connect your intellect, creativity, patience, stress management, and emotional regulation to your stated intention: to be where your feet are and give it your very best.

Your inner voice might say, "*If the wind is shifting – but instead of being angry or frustrated, I'll be curious!"* Or if your backhand mysteriously goes out mid-match, that voice might say, *"I'll pivot and consider 90% of the court my forehand. I'm going to focus and have fun!"*

In this same match, if we lock up, overcome by fear and stress, or stubbornly stick with a strategy that's clearly no longer working – well – *game over*!

We can see what's happening on the outside (*players managing on-court dynamics*). But because as we can only surmise what might be happening on the inside (*curiosity? fear? anxiety? excitement? shame? joy?*), we will offer some possible insights from the field of educational neuroscience.

BRAIN IMAGING STUDIES

In a brain-imaging study comparing students in Montessori classrooms:

- *active and dynamic*
- *multi-modal and experiential*
- *learning as a never-ending iterative journey*
- *mistakes are an opportunity to learn and grow*

With traditional classrooms:

- *didactic*
- *goal to learn and comprehend reading, writing and arithmetic content, then reproduce similar material on a test*
- *mistakes yield bad grades and academic underperformance*

on mental reactions to either *failing or passing* questions on a math test, the distinction between neural signatures endemic to each of the distinct pedagogical philosophies was revealing.

The overarching theme of the Montessori students was an activation of brain structures associated with **curiosity and creative problem solving** when they missed a problem (*I wonder where I went wrong? How can I think it through differently the next time?*) and took longer pauses after missing a question than did traditional students to figure out why. When they answered correctly, the brain imaging was unremarkable and inferred **business as usual** (*Ok, got it. Time to deploy my cognitive resources elsewhere)*[115, 116].

The students in traditional classrooms revealed neural signatures that implied **business as usual** for *incorrect* answers (*Hmm…missed it. Bummer. I'll move onto the next thing.*) and took less time than did Montessori students to process why. For correct answers, connectivity patterns that fortified information they'd learned in the past (*I've got to remember that precise nugget of information for next time!*). But what happens when aged informational nuggets have outlived their shelf life, no longer relevant to a complex and time-sensitive problem that needs solving?

Do we want to build brains that view *learning as a lifelong process*, in the spirit of the wise words of the legendary Billie Jean King, whose neural signatures say: ***"It's not failure, it's feedback!"***? Or those hanging onto the lifeboat when the ship needs to sail to new places?

This is the world we are living in today! It's changing by the nanosecond, and the people that will do best are the ones who have the wellness skills, emotional intelligence and flexible minds to adapt.

The open-skill sport of tennis – by virtue of network connectivity patterns built through play – may just help our junior players build brains wired to ***"skate to where the puck is going to be"***, in the words of Wayne Gretzky. While at present we are not aware of any specific studies on this topic – there's a reasonable neuroscientific case to be made.

And here's the hypothesis.

Wiring a young brain to evaluate a situation, drawing on data from both inward- and outward-facing networks to predict, problem solve, reflect, reset and strategize – to bring their best

to bear in a challenging situation – may involve similar cross-network connectivity patterns they fortified learning to use these very same skills to *outlast a crafty opponent on a windy day*!

"On the fields of friendly strife are sown the seeds that on other days, will bear the fruits of victory."

– General Douglas MacArthur

Tennis is the field of friendly strife that may bear the fruits of victory in life! By developing the kinds of healthy 21st century minds equipped with the inner toolbox to *lean into stress and build resilience, think outside of the box, and map their own intentional routes out of difficult situations* – this becomes a part of their story – an owned experience that builds self-efficacy.

Further, as they integrate cumulative life experiences into their personalized constructive developmental webs – making self-driven judgement calls that opt for *the hard right over the easy wrong* – those which infuse confidence and competence into broader self-narratives – these new-and-improved stories become their 2.0 starting point for what's next – with further iterations and upgrades sure to come in the future.

This is a vision for how tennis can help build the healthy, flexible, and adaptive minds that will help our young players not only survive – *but thrive* – in the real world.

PHYSICAL LITERACY

Now that we've talked (a lot!) about the brain, let's talk about the body. It's essential to note that – particularly for young players – experimenting with multiple sports is vital. Healthy development entails building synergistic physical skills, a construct called "physical literacy" –

defined as being able to "move with confidence and competence in a wide variety of physical activities."[117]

Sport sampling (experimentation) helps young people avert all-too-common overuse injuries and burnout that comes with the intensity of early specialization (remember, the goal is FUN!)[118-122]. One 2017 survey found that a majority of the athletes who *valued* multiple sports, and who *played* multiple sports – even through college – were likelier to be elite athletes – a story they share with our Olympic athletes who compete at the very highest level[123]. These athletes specialized later, leveraging childhood and adolescence to *cross-train across sports* to develop a broader base of physical literacy.

Giving players choice to express their physical acumen in varied sport settings that mobilize their own unique complementary motor and mental skills (running, balance, agility, speed, coordination, jumping, emotion regulation, on-the-fly strategic thinking and decision making) throughout childhood and adolescence is the most direct pathway to physical literacy. When an athlete makes their own choice to engage in a sport – *just for the fun of it* – with no coercing or pushing from the adults in their lives, it amplifies the odds of a positive experience – and increases the odds for retention[124].

Why is physical literary important?

Because research shows that individuals who participate in various kinds of physical activity are more likely to *stay active for life*, reaping the mental and physical health, cognitive, mood, stress management and creativity benefits that regular exercise has to offer[125]. Mother Nature's Oxygen

Mask is never far away, and only entails putting one's shoes on and walking out the door – whether carrying a tennis racket or not!

THE SCIENCE: Cultivating Attitudes and Relationships

To encourage young people to choose participation in tennis amidst many competing alternatives, get them off their screens, and to both engage and retain junior players into and throughout adulthood – coaches, administrators, and parents must prioritize fun.

Why?

THE FUN FACTOR, AND WHY IT'S IMPORTANT

Scientific research shows that engagement (FUN!) is the #1 reason kids stick with sport – or after-school activity – for that matter, over time[126]. Out of 81 total responses that young athletes report when indicating why they play sport, winning is squarely in the middle of the pack at a rank of #40[127]. The conduit for engagement and retention is the presence of a high-quality relationship with a coach of character – a trusted, consistent, caring, and supportive adult who:

- cares about the young person, values their unique characteristics, and knows their story
- understands the power of modeling positive behavior and *walks their talk*
- "gets" the bigger picture of "playing to learn" instead of "learning to play"
- believes that goal #1 is engagement and fun: ***THE WHY*** behind why kids come back for more

The essential point to remember is this. The fun factor stimulates positive brain chemistry – that generated when an individual is fully engaged in an activity they enjoy. This biochemical rocket fuel stems from the emotional valence of joy (remember, emotions are the strongest neural wire to long-term memory of them all), embedding a *positive feeling about the experience that transcends words* – it's a *felt sense* that flies below the radar. This positive energy fuels *intrinsic motivation*, which within the *sacred space* of a high-quality coach ⇔ athlete relationship, sets the stage for lasting on-court learning experiences that make hard work feel like fun.

Bottom line: FUN is the name of the game!

COACHES OF CHARACTER

Trusting and nurturant coach ⇔ athlete relationships are the non-negotiable conduit to positive youth development through tennis[128, 129]. Showing genuine *care* for the young person, pushing them to break ground into new territory and *improve*, helping them *set and achieve new goals*, treating them with *respect* as a rule, and through tennis, *connecting* them with ideas, people and experiences that can broaden their worlds[129] – all which are integrated into their ever-evolving stories – is the basic formula for how coaches change lives.

Coaches of character educate their players by modeling honorable and adaptive behavior, and by being purveyors of *positive stress* (something scientists call "eustress") in an environment in which young people can be challenged, win, lose, fail, succeed, manage frustration and joy, regroup, and grow. In this, they can provide a type of comprehensive multi-level educational experience simply not possible in an academic setting.

Many excellent coaches have an intuitive understanding of human nature, the developmental process, and a deep love of a particular sport – and approach the role of coach through the lens of an educator. John Wooden and Coach "K" fall into this category – coach educators with a primary overarching purpose of whole human development[130, 131].

Education through sport is their lens from the very start, and it is by these metrics that they evaluate success. Moreover, because the positive emotional climates they create for their players also happens to be the recipe for optimizing athletic performance - the icing on the cake is comprised of NCAA titles and teams that will forever have legendary status in history. And their athletes can remember, many decades later – exactly what they said, and in nanoseconds can call up the feeling of what it was like to be in their presence.

All because of that strong emotional wire – the most powerful of them all – especially early in life.

Leveraging tennis to develop the whole human being, for some, will entail learning and embedding some basic skills, with user-friendly, practical scientifically grounded content designed for Level 1-4 USPTA and USPTR coaches. Moreover, for coaches who choose to specialize in holistic youth development through tennis at the highest level – educators to the core – additional developmentally grounded content at the intersection of sport, education and medicine can be developed – akin to an "Applied PhD in Holistic Youth Development Through Tennis".

In this case, rather than incremental professional development content as part of the education and certification pathway, this advanced degree would build focal skills that enhance the ability of a coach to leverage the tennis experience as a vehicle to develop the whole child. Perhaps a novel cross-disciplinary academic field may emerge from this basic idea, one that gives rise to a new kind of educator – *an athletic educator* – who garners the respect and remuneration to match, providing experiences that are both complementary and synergistic with school-based learning.

DEVELOPING WHOLE CHILD COACHES

For this vision to unfold, *three main areas* of coach skill-building must remain front and center. These overlapping content areas are at the same time both *unrelated to technical and tactical elements of tennis – and also intimately related* – as high-quality coach ⇔ athlete relationships are the vehicle that helps all learning stick!

First, Developing High-Quality Relationships. Trusted, consistent, supportive and caring coach ⇔ athlete relationships are the conduit to learning and cultivating these kinds of relationships – which requires a level of self-awareness, emotion management skills to shape communication (tone, messaging), and built-in stress management tools (to capitalize on emotion-laden teachable moments).

Second, Insight into Child and Adolescent Development. All adults whose roles entail nurturing the nature of our young people, benefit from understanding basic elements of how children develop, grow and learn. For a coach, educating via tennis entails gaining a holistic

picture of who they are and evaluating how they can be best served by their time on the court (sharpening a volley, mental toughness training, or simply as a place to heal), developing a collaborative learning plan aligned with their goals, and scaffolding them in achieving these goals – then going on to establish new ones.

Third – Boundaries. Coach ⇔ player relationships, at their very best, are by nature highly personal, intimate – and platonic – relationships. The traumatic developmental aftermath of a violation of implicit trust – given the built-in power differential, and the fact that for many young people, a coach is *so much more* than just a nice person helping them learn a game – means that boundaries must be upheld at every step of the way.

Human relationships are inherently complex, and because the emotional wire is the strongest, this strong emotional pull can lead to poor decision making by adults in moments when *hard-and-fast, black-and-white boundaries* erode into a burry *shade of gray* – becoming judgment calls rather than shard and fast rules.

Maintaining healthy, respectful, appropriate boundaries is – 100% of the time – the responsibility of the adult – and must be a required part of what coaches must both ***learn*** and ***understand*** in order to have the right to *nurture the nature* of our trusting, dynamic, malleable, talented young people, on the tennis court with a the special person in their lives who is helping them find their light and let it shine – all at a time in brain development when experiences are likelier to last for life – for better, and for worse.

Negative or traumatic experiences, ones that may have started as healthy coach ⇔ player relationships before the boundaries became blurred, can cast long neural shadows that wreak havoc on all elements of healthy development – including foundational health – across life.

Just as Coaches of Character intuitively understand how to cultivate high-quality relationships with their players, have innate social-emotional skills to use both positive and negative emotion wisely to teach powerful life lessons, and instinctively know enough about human development to approach each individual unique athlete with the holistic lens of an educator – they also understand the vital importance of healthy boundaries – and don't go near the line, much less cross over.

Instinctive relationship building skills are not an automatic skill set for all coaches – nor all human beings!

Children (who eventually grow into adults) *learn how to be in relationship* by watching their parents and interacting with the adults in their lives – and doing what they do – something called "modeling"[39]. For coaches who aspire to change lives through tennis, a goal more readily attained after shoring up skills in the relationship development arena – even a small dose of user-friendly, scientifically validated skill building in emotional intelligence, insights into child development, learning and growth, and the importance of setting healthy boundaries – may be just the support they need to bring their story to life[19, 132].

Collectively, these three content areas can build skills aligned with The Search Institute's five fundamental ingredients in the "Developmental Relationships Framework" (italicized in the opening paragraph: *show genuine care, push to grow, help set and achieve goals, mutual respect, broaden world through experiences*), and may be helpful guideposts for creating content the kinds of coach educators that can move junior tennis in the U.S. toward the USTA's long-term vision of holistic development and lifelong engagement with our extraordinary game[129].

Knowledgeable, technically and tactically skilled, emotionally intelligent athletic educators understand that tennis is a powerful form of multi-modal learning. They approach tennis through the lens of an educator, meeting the player where they are on that day, weaving in relevant and timely life lessons in individualized ways, and in some cases – noticing that their player needs space to breathe and heal – and for that child, on that day, tennis is about recalibration and hope, rather hitting a perfect forehand.

Coaches of Character know above all that by supporting their players in a development plan that may change by the week or even day, that support, trust, caring, and FUN - all build *owned* capacity in that young person using their own unique gifts – whether they are athletic, intellectual, creative, social, empathic or musical – when they step off the court into their broader lives.

SAFETY FIRST

It is vital to acknowledge that within the tennis context the coach ⇔ athlete relationship must be cultivated as a sacred and ***safe place***, which means ***zero tolerance*** for

emotional, sexual or physical abuse. This also means ***zero tolerance*** for sarcasm, demeaning verbiage, or yelling - and coach as ardent protector of the emotional climate, which means that player-to-player bullying or discriminatory comments of any kind are stopped in their tracks[133, 134]. Safety First is ***essential*** for young people to trust the process of growth via tennis, taking risks beyond their comfort zones, breaking through perceived limitations - and reaching new heights they never dreamed possible.

Without **Safety First**, *healthy whole child development simply can't happen*. Childhood adversity, if unbuffered by offsetting positive experiences (termed "PACEs" – positive and compensatory childhood experiences – see below for details), can initiate a powerful inflammatory biochemical chain reaction called "the toxic stress response".

Stress is not all bad! It is a necessary and important part of human development – and a key positive element in tennis – which at its very core – IS stress.

"Eustress" is the good kind of stress, that which we lean into in order to develop new skills, strengthen and build – when administered in the right doses, at the right time, and with the right amount of recovery[87, 88]. However chronic stress, particularly if not offset by positive experiences that neutralize inflammatory stress biochemistry, can become a literal neurotoxin in a child's developing brain and body.

Here's how this works.

ACUTE, TOLERABLE AND TOXIC STRESS

Stress – whether real or perceived – starts in the brain (hypothalamus) and initiates a powerful biochemical chain reaction that floods the integrated mind-body system designed specifically to fuel us in managing *short-term*, "**acute**" stress (*EMERGENCY! DO SOMETHING! NOW!*). It is the wiring that has allowed humans to survive over time, helping us to – for example – run away from a grizzly bear, or escape from a burning building (*Don't think! Run FAST!!!*). The fuel provided by acute stress serves its evolutionary purpose – that of survival of our species!

When stress is lasting and unrelenting, due to life circumstances such as natural disasters or the death of a loved one – or importantly – *memories of a life event* that makes us feel like we're right back in the moment when the trauma took place (emotional wire!) – something that happens mostly below conscious awareness – it can erode the healthy functioning of the mind-body system – *especially* in childhood and adolescence, given the sensitivity of the developing brain in that chapter of life.

In a nutshell, this happens because short-term acute stress biochemistry, driven by "the stress hormone" cortisol – built into the human system to keep us safe from the grizzly bear – was designed to be just that – short-term! Chronic stress, which if left unbuffered, can become **toxic** when stress biochemistry becomes a part of daily life, as it does for individuals who have experienced trauma[90].

Adverse experiences – especially in childhood – embed a felt sense that the grizzly bear – whatever that is for the individual – is always there, a constant presence lurking in the darkness, ready to jump – below the level of conscious awareness – the neural wiring of post-traumatic stress disorder (PTSD)[135-138]. While the mind might not remember specifics, and may compartmentalize particularly painful elements away – *the body remembers everything* – per the title Harvard Professor Bessel Van Der Kolk's renowned book on trauma: "The Body Keeps the Score"[139].

Because *what's real is in the mind is also real in the body* – the lasting, invisible scars of childhood adversity are profound[135]. The toxic stress response works in the same basic way as a car with the gas pedal locked in the floored position. If the driver's foot doesn't release downward pressure on the pedal, or the brake isn't applied – the car will run out of gas, the engine will burn out, or at some point, there may be a terrible, flaming crash.

This is analogous to what can happen in young people, except that the "gas" is toxic stress biochemistry, the "engine burnout" is the damage wreaked on the structure and function of their developing brain, and the terrible "crash" is the short- and long-term impairment to the body via dysregulation of the immune system and chronic inflammation[90].

Positive experiences can neutralize the toxic stress response with *upward spiral* biochemistry, and this start with a trusted, consistent adult who can help provide the unconditional support, care and meaning making that makes toxic stress "**tolerable**" – the kind that builds resilience[140].

When the buffering support of an adult is not present, the toxic stress response can set off a tidal wave of inflammatory biochemistry that can impair the proper functioning of the *immune system, bodily organs, and damage the structure and function of the developing brain – those brain centers and cross-network communication patterns responsible for decision making, emotion regulation, learning and memory, socialization, and impulse control* – at a time in life when it matters most[90, 141, 142].

Widespread inflammatory cortisol-driven biochemistry is accompanied by changes in gene expression patterns that further exacerbate the inflammatory process, significantly enhancing vulnerability to negative and costly long-term health outcomes[142, 143].

THE ADVERSE CHILDHOOD EXPERIENCES (ACE) STUDY

This is exactly what was found in the 18,000 person Kaiser Permanente – Centers for Disease Control Adverse Childhood Experiences Study[144] – which examined the impact of traumatic experiences in childhood and adolescence (before age 18) on broad measures of long-term health. The overarching finding was a linear and graded (dose-response) relationship between early life trauma and health outcomes.

The greater the dose of trauma, the higher the odds of adverse mental, physical and behavioral health outcomes – all operating through the mechanism of the toxic stress response.

The study revealed that having 4 or more ACEs was linked with at least a doubling of the odds ratios for 9 of the 10 leading causes of death in the U.S – including cardiovascular disease, cancer, chronic obstructive pulmonary disease (COPD), Type 2 Diabetes, and Alzheimer's

Disease[135, 137]. Odds ratios for *mental and behavioral health risk* are even higher, stemming from the toxic stress response[138, 141]. For our youth of color, and those socioeconomically disadvantaged – who inherently have fewer protective factors – odds ratios for negative health and behavior outcomes are higher still[145, 146].

As for school – it's not hard to understand how ACE-fueled toxic stress biochemistry might impair behavior and academic outcomes – being present with a clear head, to learn new material, connect the dots, socialize with friends and make good decisions – might be affected – and this is exactly what showed in the research. Young people with 4 or more ACEs were 32 times more likely to have learning and behavior problems, and 10-12 more likely to experiment with intravenous drugs and attempt suicide[144, 147].

It's vital to note that just because 4 ACEs were the cut-off for risk in the landmark study, what's important at the individual level is *not average* risk – but rather, per the "specificity principle" – it is the risk to a specific child, stemming from a specific adversity, the specific person or people involved, the specific place, the specific time in development, and the specific way in which their life was affected in the aftermath[148].

One ACE is MORE than enough to initiate the toxic stress response.

For example, if the single ACE is a shocking and excruciating violation of trust by a coach who is more than just a coach – more like a parent, at an emotional level – but rather central adult in the young person's life at a sensitive age and stage in development; and if the tennis context is the key protective factor in their life – closer to a lively, engaging, and ever-present

non-biological family of siblings and adult friends of all ages – the most important of which is the coach – who together collective providing a sense of *belonging and connection* that is the primary fuel source for positive development in broad contexts off the court – from home, to school, to friendships; and this highly functional system is abruptly disrupted by a breach of trust by the very person at the center of the system, a devastating chain reaction can occur.

Think of ***removing the central relational fulcrum*** that is *the holding the young person's developmental tower of building blocks together* – the collapse causing a ***catastrophic domino effect*** across all areas of the young person's life. Everything that was once known and predictable, is suddenly and chaotically up for question.

They think: "*If this happened with my coach, who I trusted more than anyone, then who can I trust*?" "*Are all adults like this*?" "*Did my coach really believe I had talent and potential*?" "*Am I safe coming to the courts after school to see my tennis family when my coach is still here*?" and "*Do I want to play tennis anymore at all*?"

Moreover, because human beings operate in dynamic systems of relationships, where emotions are contagious, a single ACE that disrupts the entire system a young person relies upon for stability *doesn't just affect the individual – but their family too* – as well as all of the *other relational systems* in which they engage – at home, at school, and with the tennis family that was once the center of their world.

This system-wide disruption of positive holistic development also sets the stage for additional ACEs, and here's how. Depressed and anxious teen, reeling in pain, searching for

stability, behavior problems begin ⇔ loads complexity into the household emotional climate <=> triggers parent underlying *mood disorder* ⇔ parent *emotional neglect* ⇔ two more ACEs (*italicized*) – which can, if not buffered by PACEs, exacerbate the toxic stress response and set the building of resilience and process of healing that much further out of reach.

Note the bi-directional arrows, which do not indicate causality, rather – cross-pollination. The energy exchange of each household emotional climate factor works both ways.

Toxic stress biochemistry is cumulative, and when the homeostatic (normal) molecular balance in the mind-body system changes drastically – this sets off a biologic chain reaction that affects other cellular-level processes[36]. Our physiologic systems are integrated – through and through – and as we recall, the same biochemicals that affect the brain – also affect the body – which means that the inflammatory toxic stress biochemistry that permeates the system under the skin, is the biologic precursor for that which is observable on the outside – in behavior, mental and physical health, academic achievement and other widely tracked aspects of youth development.

The toxic stress response can be compared to neurobiological avalanche in the life of a young person, a leveling of epic proportions – one that shears down everything in its path, dismantling a carefully constructed system of activities and relationships that once paid broad developmental dividends. All because a system that once was trustworthy, predictable and routine, operating day after day like a well-oiled machine – *structural factors that are vital healthy child and adolescent development* – fell away all at once.

The magnitude of trauma's impact on a young person is magnified by who the coach represents in the life of the athlete. Are they simply a tennis instructor, or a valued mentor, or a trusted reliable parent? The closer the relationship, the greater the trust, the more devastating the fallout.

Moreover, it is important to note that physical touch is *not* required to meet the legal classification of sexual abuse. Adults are – ***as a hard-and-fast black-and-white rule*** – responsible for maintaining appropriate boundaries – no matter the circumstances – 100% of the time.

Coaches who cannot uphold proper boundaries with their players *must not be allowed to nurture the nature* of our young people. ***Period!***

By wiring young minds and bodies with the neural shadows of toxic stress, they are nurturing nature in the wrong direction – at a time in life when it matters most. *Trauma can ruin multi-generational lives*, and abuse of any kind has no place in the field of tennis, youth sport, or anywhere young people go to engage in activities they love, with adults they trust, helping them learn, heal, develop and grow into the best possible versions of themselves.

Herein lies the opportunity for tennis – and all of youth sport. Just as *violation of trust* can catalyze the toxic stress response – it is this very same ingredient – ***trust*** – that is the best-known ***antidote***.

POSITIVE AND COMPENSATORY CHILDHOOD EXPERIENCES (PACEs)

Relational wounds require relational healing, and tennis coaches can, and in many cases *are* – PACEs in the life of a young person[149-151]. By cultivating a *high-quality developmental relationship* that helps the young person ground and reset, a coach can help them transform toxic (chronic) stress into tolerable (resilience-building) stress and begin the process of charting a new course forward[129, 152].

Such coach ⇔ player relationships are priceless in every possible way – and are extraordinary assets in the life of a young person. Developmental relationships are the central ingredient in healing ACEs – by providing PACEs – the positive buffering, stress-biochemistry-neutralizing experiences alluded to above[150, 153, 154].

In the face-off between ACEs vs. PACEs – given the optimistic story science tells about human malleability across life, 24/7, 365 days a year, the epigenetic process of nurture shaping nature – *most powerful during childhood and adolescence* – specific PACEs, at a specific time, at a specific place, in a specific young person's life – have the advantage every time. In a metaphor with special resonance for tennis players:

Coaches of Character can help a young person ***Return an ACE – with PACE!***

It's these coaches, and other key adults who may play a particular supporting role at a particular time, who can help a young person gain traction – on a journey out of the darkness, and towards the light on the horizon.

Neural plasticity, strongest early in life as we've seen throughout this developmental tennis story, means that there is ALWAYS possibility for a self-narrative upgrade to takes hold in real life. This upgrade to narrative 2.0, with further iterations in the pipeline, always starts with a caring, trusted, supportive adult who helps the young person see a new version of their story, believe it, and supports them in living their way into it.

When a player is clearly struggling – acting out, displaying disruptive behavior, negatively charismatic in some way, shape or form, or just palpably sad and needing some breathing room – in most cases there's a larger issue at hand that's not visible at a surface level. These external manifestations of what's happening on the inside are clues to the athlete's story – which may or may not include ACEs – and if this is the case, their coach can play a major role in helping them stabilize, strengthen and heal.

THE EMOTION SCIENTIST AND THE EMOTION JUDGE

Being an "emotion scientist" means having curiosity about what might be happening on the inside of another person, in an effort to understand and support. By approach a young person who is clearly having difficulty, asking "*What happened to you?*", empathic words embedded in a tone of kindness, this experience wires into a child's mind-body system the healing emotional biochemistry of being seen, valued and cared for (*upward spiral* biochemistry)[19, 34, 155]. This is the definition of a protective and compensatory experience – which in acronym form – is a PACE[153].

Because *what's real in the mind is real in the body* – and because it's *our perception of an experience* (and not "objective reality") that drives biochemical reality in our bodies and brains – this PACE experience with a coach integrates the toughest biochemical opponent to toxic stress there is – one that can take it down in straight sets – *especially if the ACE is recognized and addressed early on*[90, 106, 141].

Just as toxic stress biochemistry is cumulative throughout the mind-body system, so is the molecular effect of the mood enhancing, health promoting *upward spiral*[34, 45, 139, 156, 157].

Every incremental dose of positive biochemistry helps, because as discussed earlier – the menu items in Mother Nature's Oxygen Mask (high-quality relationships, meditation and mindfulness, attitude of gratitude, growth mindset and positive visualization) and "The Power 3" (exercise, nutrition and sleep) are all related[21, 45, 158]. Engaging in one health-supporting behavior tends to beget incremental agency in the proactive use of the others, creating a positive biochemistry cascade that helps us remove our dark percentual sunglasses – those which are painting our world a certain palate of gray – and swap them out for a pair with brighter filters!

Coaches who are emotion scientists *see the human being* on their court – notice where they are that day as a starting point to develop a lesson plan. *Are they happy or sad? Energetic or tired? Present or scattered? Is anything atypical, and if so, why?* It is a dynamic process of meeting the player where they are that day, and fine-tuning the tennis experience accordingly, in light of long-term goals and limitations. There's a broader element to the humanistic detective work too, as what's happening in the life of a young person on any particular day by

necessity integrates into a larger narrative, which the emotion scientist coach makes an intentional effort to know something about.

These intertwined strands of the young person's bigger picture life story, and what's happening in the "now", are synthesized to create a thoughtful and timely game plan for the day, in light of unique player characteristics including level of play (recreational or competitive), physical fitness, response to stress (dandelion child: highly resistant, or orchid child: highly sensitive), and cues for when to push hard (apply positive stress) and when to take it easy (recovery and connection) – as well as other individual elements of the on-court experience on that particular day that fit the current situation[159-161].

Sometimes what's most important has *absolutely nothing to do with tennis*! The order of the day for a coach may be cracking a great joke – one that makes the player laugh so hard that their eyes crinkle and fill with tears – or putting full awareness and attention to listening with a kind ear, helping the young person feel seen, cared for, and valued as a human being.

This is the mysterious puzzle that the emotion scientist coach aims to solve every time they step onto the court with a player. Such coaching requires effort and insight, and while it may sound like a tall order, what's clear that it is within these types of coach ⇔ athlete relationships that miracles happen, like V-shaped bounces off the bottom of a developmental spiral, perhaps fostering a lifetime of feeling that the tennis court is a place that instinctively calls to the player, throughout life, as a reliable place to de-stress, heal, and walk off the court feeling better than they did walking on.

The mind-body dynamics of tennis play and relational quality with a caring coach, tips the player's molecular balance of positive mood-altering biochemicals to the upside – helping the sun shine through on an emotionally cloudy day.

And if the sun is already up there, casting its warm rays from high in the emotional sky, the energized, engaged, intrinsically motivated player leans into the stress that their emotion scientist coach creates – *knowing it's a good day to push hard* – and the same real-time biochemical chain reaction is deployed toward leaving nothing on the court that day. The felt sense after play is one of being one step closer to achieving a long-term goal that keeps getting pushed out…as the process of learning and growth has no finish line[19, 106, 139].

And tennis is a journey, just like life.

Tennis as a means to an end is a story that *can and does* unfold on the myriad levels described throughout this story. Over time, particularly if a player gains a sense of confidence and competence from *embodying* the multi-level developmental assets tennis has to offer – all while having FUN with a coach they know is in their corner – their positive narrative about tennis, and the myelinated-and-automated habit of playing several times a week with their friends – for life – becomes a part of their regular routine.

These experiences *are the seeds of retention and engagement*. Later in life, tennis is a "get to" rather than a "have to", an eagerly anticipated experience, prioritized as a calendar appointment in the same way as an important meeting. Perhaps even bumping the important

meeting out of the top priority slot on days when mental wellness is the larger goal, and the medicine of tennis with a good friend is *just what the doctor ordered*!

The positive biochemical ripple effect of the "emotion scientist" coach stands in direct opposition to that of the "emotion judge"[19]. Sharply probing words, encased in a harsh tone and delivered as other players look on – "*What's wrong with you?!?*", wires into the young person – one who is presumably already struggling in their broader life – a big thorny question mark about the coach, all the while reinforcing the neural pathways connecting an emotion-laden *bad* experience with the game of tennis.

The downstream biochemical effects are molecular by-products of blame, shame, frustration and dismissal (you guessed it - the stress response), embedding in their brains and bodies at a biochemical level[142, 162]. The player thinks: *"Remind me why I'm out here again??"*

The greatest tragedy occurs when our at-risk youth, those young people who need emotionally intelligent Coaches of Character *more than anyone* – to provide safe, fun, stimulating and intrinsically motivating on-court experiences where they feel a sense of connection and belonging – all which may be positive life experiences they need for healthy development but are not getting at home or in school – find themselves on the court with a critical coach playing the part of emotion judge – unempathetic, and perhaps dismissive and/or verbally abusive too.

This negative relational coach ⇔ player dynamic erodes the potential for retention and engagement, enhances the odds that the young person's struggles continue (*one more*

experience of not being good enough, valued, seen nor cared for), reinforcing an already downward-sloping trajectory in life.

What must remain front and center for coaches – particularly those working with our disadvantaged youth – is simply this. Tennis, during the specific life chapter when they are on your court, may be their *singular chance* to break free of a negative family cycle and a hopeless, intractable narrative that has spanned generations. *Initiating a new positive cycle*, one that can launch a young person into an adaptive 2.0 future, starts with a coach who helps them see a new story about what's possible for them, the athlete believing it (*their trusted coach said it was possible so it must be true!*), then – embarking on the journey of living their way into it.

More than just beating the odds, these are the young people who *change the odds* – not only for themselves, but *also for others who follow in their path*.

This iterative developmental story starts with Coaches of Character who are educators first and foremost. They create high-quality relationships and on-court experiences that make tennis FUN, with a primary goal of developing the whole child. Positive early on-court experiences create sticky, lasting emotional wiring, fueling happy narratives about the meaning of tennis in the broader context of their lives. These conditions will yield the highest probability of engaging and retaining our juniors for life – per the vision set forth by the USTA.

MULTI-GEN TENNIS FRIENDS & SOCIAL-EMOTIONAL LEARNING

As discussed in "Safety First", in addition providing the kind of positive stress (*and not chronic - or worse - toxic stress, which can damage the developing brain and immune system*) that

drives *GROWTH* and *FUN*, we must acknowledge the importance of ***tennis friends*** – especially in the time of COVID – when tennis sometimes provides the only opportunity to engage with another person outside of our bubble.

Human beings are social animals, evolutionarily designed to rejoice together in good times, and to support one another through strife. Our bodies and brains are wired accordingly, making high-quality relationships and social networks a central factor not only in mind-body wellness and holistic youth development, but also – of course – in healthy aging[163-166].

Without other humans striving together toward a broader purpose – the collective efficacy (1+1=3 / stronger together than apart) that arises when the young take care of the old, the healthy take care of the sick, and we leverage the unique neurodiverse capacities of those in our communities – our species would have gone the way of the dinosaurs a long time ago[167-171]! We were designed to be in relationship with one another, a biologic fact highlighted by a study on the effects of social isolation which, through the mechanism of the stress response, was found equivalent to either smoking 15 cigarettes per day, or the multi-level health risk of being obese[172].

This discussion of humans as social animals, and the neurobiological "positive feedback loop" catalyzed by conversation and connection, begs the need to touch on the definition of tennis as an "individual sport"[168]. Tn truth, tennis play is an activity we engage in with friends. Unless we're hitting on the backboard or practicing serves – which can also be restorative as *self-directed solitude* in the right dose and time is healing too - social interaction is an *integral part* of the tennis experience, and a key factor in its health promoting effects[5, 173, 174].

The school-aged years of childhood and adolescence are typically focused on teaching our youth people to read, write, have an understanding of science, and build basic mathematical skills. This notwithstanding, it can be argued that the larger goal for this life chapter is socialization – *developing, managing, and negotiating relationships with their peers and the adults in their lives*.

Play between tennis friends is characterized by drills or match play, interspersed with sideline and across-the-court conversations – which makes for a wonderful setting to create and nurture friendships with older and younger peers.

But because the only requirement for play is a roughly equivalent level of skill and a love of hitting the ball, tennis offers an exceedingly unique opportunity to cultivate rich multi-generational friendships that can offer wisdom, support, comfort, laughter, and a different perspective on life. And on a humorous (yet practical) note - juniors, if they're lucky, may gain valuable insight into a *wily strategic tactic or two* as well – squirrely unexpected (yet legal) tricks that come in handy in a tight match!

The Universal Tennis Rating (UTR) system will soon be instituted across the tennis world, enhancing the multi-generational, multi-cultural, cross-pollination of life experience, perspective and friendship opportunities that are endemic to the thoroughly unique lifetime sport of tennis, bringing us closer together as a global tennis community[175].

Further enriching this connective community dynamic is the USTA's commitment to providing play experiences for our neurodiverse and adaptive athletes, as codified in "Tennis for All Abilities" within the American Development Model[176]. Tennis, for these extraordinary human

beings – from our Special Olympic athletes, to wheelchair players, to our courageous military veterans just picking up a racket for the first time – is a biochemical fuel source and an outlet for healing – as it is for all of us.

On a deeper note – leveraging tennis as a vehicle to help our young people (and us older ones too) embrace individual differences – learning from one another and *connecting not role-to-role, but soul-to-soul* – is the larger – immeasurable outcome of the USTA's commitment[176, 177]. As we know, relationships are a *bi-directional* energy exchange that offers a dynamic cross-pollination of life experience and insight[41, 42]. When our juniors share a multi-modal learning experience with someone who *seemed so very different and unrelatable* at the start, then through play, *perceived differences narrow, perspective broadens*, and an *energy pathway opens up* fostering an unexpected – and welcome – sense of connection – it's *the definition of a priceless life experience*.

Because through on-court play, these two people found common ground as human beings.

Such life experiences, especially for our youth given the sticky neurobiology of the early years, can provide a *felt sense* that stays with them for life – influencing how they operate in their own dynamic systems in subtle ways – across life – permeating mindset and behavior decades later, *in ways that no research study will ever capture*. Thoughtfully designed, innovative and inspiring programs of exactly this kind are currently underway – potential models for scaling and adaptation[178-181]. By connecting tennis lovers of all ages, cultures, minds, abilities, backgrounds and life stories via program designed with a guiding principle of "tennis as a means to an end" – our tennis community and our world is undeniably better for it.

These human-to-human connections, insight into how despite being different – we are all the same – are life experiences offered by tennis that are hard or impossible to replicate in other settings – because of the strong multi-modal learning context and powerful emotional wire.

One final note on human connectivity and tennis friends, specifically with regard to the high-quality relationships that stand the test of time. In the best of all possible scenarios, usually with a very small handful of very special people – tennis offers *lifelong friendship and unconditional love* – a bi-directional life-affirming dose of oxytocin (and don't forget exercise biochemistry) that we can count on – like the sun rising to the east and setting to the west.

These soul mate friends provide shelter and warmth on days when the emotional clouds are looming, like a big sturdy umbrella that will keep us dry if the skies open up (children, families, relationships, work crises and life stressors that *keep us up at night*). When the storm passes – as it always does – these friends jump right out into the sunlight to share in our joy when the storm, of all things, gave rise to exquisite natural beauty that did not exist before (children, families, relationships, work crises and life stressors that were *resolved in a way that spawned growth and expansion for all*).

We grow in the shelter of others in our lives, and these tennis friends are the "upward spiral" fueling stations who stick with us through thick and thin – there in spirit when they can't be there in person – offering a soft shoulder upon which to rest our head when life is hard, and are the very embodiment of "mudita" (experiencing our joy as if it were their own) when the tide has turned[182]!

These precious friends keep us healthy, connected and engaged, and are, for many players, the most special of all – a combination of their favorite physical activity and the people they love the most. And it doesn't get much better than that!

"SENIOR" TENNIS & HEALTHY ADULT DEVELOPMENT

As we turn our lens from child development toward adult development, two major findings can serve as beacons for our journey into elderhood.

In a study conducted at Yale University, the research team found that individuals with positive perceptions of aging – those who had wired their brains to conceptualize aging as a journey that yielded the gifts yielded wisdom, perspective and depth – lived on average 7.5 more years (*upward spiral biochemistry*) longer than those who viewed aging as descent into societal uselessness, disregard and isolation (biochemistry of chronic stress)[183]. Relatedly, the Harvard Study of Adult Development found that it was not IQ, success, fame, nor money that had the most profound impact on health – but rather, the quality of relationships with the people in our lives[164].

Connecting these two important studies and layering on the finding that 40% of our happiness (medicine in every sense of the word) stems from our outlook on life and intentional engagement in activities that bring joy illuminates the vital health-promoting importance of surrounding ourselves with people whose presence feels like sunlight, who are reliable, consistent and compassionate journey mates on a road we are all on together.

The road of life is long, windy and bumpy, and having friends whose stories are intimately entwined with our own, with whom play a reprieve from the stresses of life - and sometimes a form of powerful therapy – makes all the difference in the world.

These friends say "yes!" to a hysterical game of lefty short court when a maddening injury has the dominant hand out of commission, "yes!" to the idea of a long walk and talk when tennis isn't in the cards, and "yes!" to a long conversation about pretty much anything under the sun, happy just to talk by phone, hear our voice, or receive an emoji-laden text – in a *molecular-meets-quantum energy* exchange of upward spiral biochemistry that fuels the emotional tanks of both[184].

These friends *nurture our nature* in the best possible way, providing a collective echo chamber of adaptive thinking about aging, health, and life.

All of this brings us to the USTA "seniors" categories (which start at age 30 – *can 30 really be considered "senior"???* – and runs through age 90!). We play for just for fun – singles, doubles, drill sessions, and competitive leagues – and if we're still competing, we travel to tournaments – predominantly with people we choose. These friendships – at all levels – catalyze the shared positive biochemical fuel of joy – rain or shine – and the bonus of exercise biochemistry from the "*moving meditation*" that is the game of tennis.

Atop joy – which is good for our mental and physical health – tennis layers on "interval training" – a form of exercise with specific protective health benefits[185-187]. The friendship – interval combination is abundantly good for our health, and serves as:

- a biochemical buffer against chronic stress

- a molecular boost to emotional well-being
- upward spiral fuel to the dynamic systems of relationships we operate within, at home, work, in our community, and at play (*emotions are contagious – for better and for worse!*)
- an enhancer of longevity

In fact, in a large-scale comparison of tennis players with those engaging in other sports – it was tennis that showed the greatest mortality benefit, with a 9.7-year average longevity benefit versus sedentary individuals[5].

Reflecting on these results in light of the Yale and Harvard study findings, the *unconditional-love-lifelong-tennis-friend + open-skill-exercise-biochemistry* is a powerful combination – and as hypothesized by the Copenhagen Heart Study research team, these two factors were the major drivers of the results. The headline: for a scientifically grounded way to keep our brains and bodies healthy, maintain a strong and consistent social network, and live an active, high quality life into one's golden years - tennis provides a compelling option that's hard to beat!

Moving now from the chock-full-of-life senior's categories back to our youngest juniors, where a tennis seed planted in the mind of a young person, if nurtured and supported, can pay extraordinary dividends across life. The conduit to junior engagement – as a rule – is a high-quality developmental relationship with a coach of character, where on-court play and conversation make time fly, accrue mood-altering, creativity-fueling biochemical dividends to the integrated mind-body system. All the player knows is that *it just feels **good** to be on the court, hitting the ball.*

As a result, they come back again tomorrow – to try and hit it even harder!

The important developmental assets offered by tennis, if it becomes a young person's game of choice for all the right reasons, can be a vehicle to a better life. But pressure to play based solely on this logic puts the cart before the horse – and should be no part of the early tennis experience. Childhood is a perpetual state of *human being, rather than human doing* – a multi-faceted off-road adventure that should be all about discovery, adventure, play – and of course – FUN!

Tennis can offer all of these things. When young people have agency and choice to opt for sports that resonate most, whatever the reason, what's clear is that intrinsically motivated drive (relative to pressure applied by someone else) carries the proverbial ball a much greater distance over time[188]. Child agency and choice are like a high protein meal that sustains over time, versus a candy bar that provides a quick short-term burst of energy then quickly goes "poof".

Starting with FUN plants early life tennis seeds that will most naturally germinate into lifelong players who are still madly, deeply, and hopelessly in love with the game at 90 – cognitively sharp, physically fit, and living their best lives. *Indeed, this is a vision of adult development that we can all aspire to!*

WHAT CAN THE USTA DO?

To create optimal conditions for diverse young people across the U.S. to **learn and love** (engage + retain) the game of tennis – we must strive to provide access and opportunity to young people *regardless of race, ethnicity, culture, socio-economic background, gender, gender identification, and religion*. Access is the largest roadblock across youth sport, and while tennis is no

exception – the USTA Foundation continues to do excellent work in providing both in- and out-of-school time opportunities to make tennis accessible for all.

While USPTR and USPTA coaches are steeped in level-appropriate tactical and technical knowledge, the USTA must continue to develop and offer educational content in the science of learning and child development too. The coach education team is in the process of doing just this – but can the process be accelerated with strategic cross-sector partnerships? In short, YES. Consider this:

Developing coach education content of substance and value will require a considerable investment of time and resources, as the literature – in its current form – is *highly undigestible* to all but a small handful of scientists and researchers who read, understand and are actually interested in (frankly, riveted by!) peer reviewed academic publications. These important and relevant papers are crafted using mind-numbing multi-syllabic words, written in a language that can – even for high-level readers – can trigger rapid-onset narcolepsy!

If new scientific information, while interesting for a coach to ponder (*hmmm…cool…but how does that apply to real life?!?*), doesn't have *meaning, relevance or practical application* for them or their players – *then what good is it?*

Developmental concepts and paradigms must be conveyed in an understandable, engaging and sport-specific way that can "land" with a coach, who can then consider how this new knowledge integrates into their own existing "constructive developmental web"[103]. Moreover, of

equal importance is reflection on what this new knowledge might mean for their philosophy as a coach – particularly one who has historically held winning as the ultimate goal[103, 189].

The content must then go through a rigorous evaluation process to see if, over time, it fosters behavior change in coaches that in fact leads to improved outcomes of various types for our junior players. This necessarily requires an investment of a coach's time and energy to embed new knowledge and a new language, apply learned concepts on the court with real players, reflection as to what's working with which players and why (and why not), and consistent reinforcement of these newly myelinated neural pathways so that they become habit[111].

To be done well, something all of our young athletes across all sports deserve, this process of content development for coaches will take time – though less so with collaborative partners who are singing from the same songbook and following the same strategic plan.

Notably, developmental content integration is a process the USTA has already begun. To date, the coach education team has delivered a module on the 5 C's of Positive Youth Development (confidence, competence, connection, character and *creativity – USTA substitute for "caring" in the original 4-H Study)[190] to Level 1 coaches, and is currently preparing a deeper dive into the same subject area for Level 2 coaches and beyond. By making the 5 C's of PYD a concrete focus, coaches can get creative about bringing these constructs to life on the court, in their own unique way, knowing that science shows clearly that these factors matter – a lot – in the life of a young person.

This is only one small example of how understanding a few basics about how positive youth development happens can help. Building coach skills and content knowledge to create positive

emotional climates that can bring PYD to life in the real world for real junior players – is *essential* for doing the job well[19, 132, 191]! And this all starts, of course, with ***safety first*** and ***clear boundaries*** in coach ⇔ athlete relationships.

Finally, coaches are, like all of us – human beings who have good days and bad days. Building skills that support coach self-care (Mother Nature's Oxygen Mask) and strengthen emotion regulation – both to show up as their *best selves*, and also to recognize then capitalize on emotionally charged teachable moments – are essential steps[21]. *By supporting our coaches*, we give them the best chance of *supporting the holistic development of our junior players*.

Moreover, to get all of the adults in a young player's life onto the same page, we must educate, support, and engage coaches *and* parents in a way that amplifies the #1 reason kids stick with sport (and all out-of-school-time activities) over time – FUN[7]!

When we understand that science demonstrates, beyond a shadow of a doubt, that *the early years are the most powerful for development, laying foundational pathways for brain connectivity and immune system function that support health, happiness and productivity for life*, we also understand the significant opportunity for the USTA to capitalize on this moment in time and change the narrative on what engagement with the sport of tennis really means.

To accomplish the overarching goal of helping players of all ages – with a focus on younger players – fall in love with tennis (engagement + retention), cross-disciplinary collaboration between the USTA and partners in sport, education, medicine, public health, and advocacy must align in an

unprecedented manner. Bold initiatives requiring careful planning, thoughtful leadership and financial resources will be required in order to:

- Be SMART: Develop Specific, Measurable, Actionable, Realistic and Time-bound strategic goals that inform the roadmap forward, starting with a coach education-and-accreditation pathway grounded in the science of learning and child/adolescent development, and creating consistent opportunities for play to our youth living in marginalized communities.
- Change the Scorecard: *Measure key variables* that relate to and support the life-long mental and physical health, character, social-emotional learning and productivity of our young people.
- Focus on FUN! Take the emphasis off of winning and losing, place it squarely on engagement, fostering on-court emotional climates that catalyze intrinsic motivation, increasing the odds of the BIGGEST WIN OF THEM ALL – the *extraordinary developmental assets and preventative health behaviors* that the "open skill" sport of tennis can provide throughout life.

Although placing a central focus on holistic youth development through the sport of tennis is specific to the USTA, there is tremendous potential to both lead and collaborate with the other 53 National Governing Bodies of the U.S. Olympic and Paralympic Committee, and other strong partners – in a collective effort to equip coaches at all levels with knowledge and skills to optimize whole child development through sports of all flavors and varieties.

THE BIGGER PICTURE: YOUTH SPORT ACROSS THE U.S.

Not only is the science of learning and development absent, in general, from coach education across youth sport – from volunteer to elite levels – but also at the higher education and graduate school levels where master coaches and sport administrators are being prepared for future leadership roles across sport – youth, NCAA and beyond[192].

Incidentally, a similar dearth of developmental training is evident in the field of education, where teachers typically receive minimal coursework (on average one) in child development during the their pre-service training[193, 194]. The Science of Learning and Development Alliance (SoLD), a collaboration that includes leading names in the fields of education, positive youth development and advocacy, is working to change this[191].

It is this body of scientifically grounded knowledge that now has the opportunity to make its way into the field of youth sport, including a soon-to-be-released "Developmental Playbook" that outlines a roadmap for skill-building in adults who lead out-of-school-time activities. Integrating what we know about how deep learning happens, and training coaches to create sport environments that strive to match unique assets of each individual child with specific athletic experiences in ways known to best promote their positive development – holds promise – and seems a clear and marked improvement over the system in place now.

Clearly, this is a multi-pronged, complex, system-level issue, one that will require the simultaneous movement of many sets of wheels collectively progressing towards a shared goal – that of developing a thoughtfully-designed system that can stand the test of time – delivering coach

education that shapes *meaningful and measurable* positive outcomes for all of our young athletes over the long-term.

As discussed earlier, new developmentally grounded content will require translation, packaging into modules, piloting, evaluation and implementation in a way that has impact and staying power (sensitive to racial, cultural and gender identity).

This will require collaboration between sectors that have a vested interest in youth sport – but at present – are atypical partners. This includes the fields of academic research (identify relevant developmental literature), pediatric medicine (American Academy of Pediatrics + scientific publications on child and adolescent health), education (science of learning and development, best practices, effective content delivery, principles of trauma-informed teaching), sport (USTA, NGB partners, USOPC, industry leaders like the Positive Coaching Alliance, Up2Us, and school-based sport associations), public health, social services – and will also require committed long-term funders across all of these sectors.

This vision includes independent funding for the U.S. Center for SafeSport.

The Center received additional funding through the "Empowering Olympic, Paralympic, and Amateur Athletes Act of 2020", enacted late last year, which required $20 million in funding by the USOPC. This is problematic for two reasons. First, SafeSport should be independently funded by Congress, akin to the 2020 bill that provided Congressional funding for the U.S. Anti-Doping Agency[187]. Second, $20 million is simply not enough. At present, SafeSport is capacity constrained on multiple levels, limiting their ability to build the requisite team conduct much-needed research,

develop and implement program, collect and analyze outcomes data – all of which are fundamental building blocks in having the infrastructure to meet their mandate [186]. Moreover, as the Center scales to meet demand – which continues to increase at a breakneck pace – further funding will be needed to protect our athletes and keep sport safe.

Given a) the perceived conflict of interest inherent in the USOPC's funding of SafeSport, b) the value placed by our country on youth sport participation for all, athletics as a context for equity, inclusion and positive holistic youth development, and c) the fact that ***Safety First is the non-negotiable first step*** to create the conditions for sport to be just this for our young people on the courts, fields and arenas across our country – SafeSport *requires and deserves* its own consistent and protected line item in the federal budget.

Even with all of these factors in place, child-facing outcomes are not guaranteed – hence the necessity of stress-testing the hypothesis.

If we create a nationwide system that produces sport coaches who approach the sport experience – and their athletes – through the lens of an educator, how will this shape youth-facing outcomes – if at all? Despite a combination of logic and common sense that would suggest the answer to this question is "YES" – revealed in specific ways, for specific individuals, at specific times in development – collaboration, thoughtful program development, and well-designed measures must be created and implemented to understand what works, what doesn't work – and why.

The zeitgeist is highly conducive to conduct a small number of demonstration studies to illuminate this question for many reasons, including that in the fall of 2021, after the Tokyo

Olympics take place in whatever form they do – the world of sport will begin to focus on the 2028 Games in Los Angeles. Of significance, a key directive for the L.A. 2028 Organizing Committee is to elevate and promote youth sport access and participation – making the timing for this workstream exceedingly good – offering an opportunity for the USOPC and all of youth sport to tell an extraordinarily positive story of growth and innovation – the silver lining of a global pandemic that forced the world of sport to its knees[195].

With all of this said, one thing seems clear. If even a sliver of this big idea catalyzes incremental change, enhancing developmental relationships for a percentage of coaches and athletes – particularly our at-risk youth – which fosters more engagement and less attrition, increasing the likelihood of regular physical activity embedding as a lifelong habit – with all the known developmental dividends – this would be a very high-quality and high-return investment indeed!

Moreover, *culture change that honors sport as a means to an end* would be a vast improvement over the high-pressure, competitive, win-at-all-costs, travel sport for those who can afford it, sport specialized, overuse injury-laden, average-age-of-drop-out-at-11, attrition for girls earlier than for boys, *marginalized-youth-who-need-it most-have-the-least-access* landscape that characterizes youth sport across the United States today[119, 196-200].

By investing early in a child's life, given all that science tells us about neural plasticity and the myriad life-altering skills developed through sport (especially tennis!) – the ROI – over the long-term is greatest when we allocate our resources up front – and not decades later when chronic

disease, mental unwellness, productivity limitations and poor quality of life have a firm hold on the proverbial steering wheel of life[201-204].

Youth sport is an underutilized context at present, in the myriad ways described throughout this document – and as the #1 place young people choose to go after school is out – making an investment that can answer whether whole child coaching can in fact improve child-facing outcomes in a way that lifts our society as a whole – ***is one worth making***.

Engagement in one's sport(s) of choice, safely and starting at an early age – purely for physical activity and fun with friends – is an essential ingredient in holistic child development, and a basic human right that must be simultaneously safeguarded and upheld by coaches, parents, sport administrators and legislators[205-207]. Countries like Australia, Japan and Norway have codified these principles into policy – as dictated by the U.N. Convention on Rights of the Child – key elements of which can be drawn upon to guide the development of a comprehensive system here in the United States[99, 208-210].

The National Youth Sports Strategy report, produced in late 2019 by the U.S. Department of Health and Human Services, remains a vision that is not yet formally "under construction" – but the spirit is right on target:

*"We view the **National Youth Sports Strategy** as an important first step to reorient the U.S. sports culture around a shared vision: that one day all youth will have the opportunity, motivation and access to play sports, regardless of their race, ethnicity, sex, ability, or ZIP code*." [210]

For our federal government to put the muscle and funding behind this statement that can bring this vision to life – something our country needs in ways that don't appear to register at the level of awareness that motivates concrete action – the time is now.

While the story detailed in this manuscript is about the sport of tennis – ***every sport has its own version of this story*** – one that highlights the skills, mindsets, social-emotional connectivity, and neural wiring patterns which make that particular sport a means to an end. These sport-specific stories hold the nuances that intrinsically motivate a group of young people to opt for participation in one particular sport over another – and can only be written by those who know the sport, love it, speak the language – and integrate key scientifically grounded developmental underpinnings to weave a narrative that illuminates its unique holistic developmental assets – then tells the story in a way that *drives athlete acquisition, engagement, and retention* over time.

For tennis, and all of the other "sport siblings" in our diverse, open- and closed- skill, individual and team play, vibrant and colorful youth sport family, the broad and deep, life-trajectory-altering developmental assets garnered by participation across time – ***has nothing to do with winning*** **– and** ***everything to do with embedding physical activity and movement*** – wellness skill and habits that have been core elements in mammalian survival and flourishing since the beginning of time– ***at a time when developing brain is at peak potential*** to establish habits that stick for life[211-215].

The bottom line is this.

To create the conditions for our young people to thrive through sport, to offer this basic human right to all of our young people across the United States, we must *prioritize fun over winning*; tell an emotionally compelling story of the larger-than-life role regular physical activity, healthy lifestyle habits, behaviors and mindsets play across life – and help our youth FEEL these *upward spiral* biochemical effects early on – creating intrinsic motivation to play and stay active; and educate players, parents and coaches in a synergistic and accessible manner that gets the key adults in a child's life on the same page – in support of their best interests.

To begin this process, one with clear potential for multi-generational impact – ***we must rebrand youth sport as the means to an end that it is*** – and align requisite resources across all levels of our system to invest up front – when the prospective ROI is highest for each unique, talented and gifted young person, their family, their community, our country, and our world.

METAPHORICAL TROPHIES

When we have enough distance for philosophical reflection on life in the rearview mirror – the tall trophies and the hurtful disappointments, the wins and losses – the concrete measures of "success" and "failure" fade away. What takes on significance are the *metaphorical trophies* that live on inside of us. The triumphs related to our character and the way we chose to show up in the big life moments that revealed our integrity, humility, courage, empathy, and kindness.

These are stories we've carefully authored and nurtured – the ones we believe about ourselves, who we are in the world – and what *was* and *is* possible for us. Also integrated into our narratives are the stories *we helped others see*, take in, and believe about themselves – 2.0

upgrades that put them on a new path of health, hope, high-quality relationships and possibility in life.

It is *these trophies* that outweigh the others in our hearts, minds, bodies and spirits – priceless gifts that no one can ever take away. We own them, and it is these qualities that are remembered by the family and friends that love us the most. Now THAT is a win.

Leveraging youth tennis *as a means towards this end*, at this precise moment in time, would be the biggest win of all. It is time that we as a tennis community of players, parents, coaches, administrators, and policymakers commit to giving our young people the healthy, productive and meaningful lives they deserve. THIS is our True North.

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