



# **A Multifaceted Approach for Mental Performance in Sports**

April 2021

Nicholas Davenport M.S., Director of Programming/Owner

## Table of Contents

<b>Abstract</b> .....	3
<b>Introduction</b> .....	3
<b>Mental Performance Defined</b> .....	4
<b>Interactions Between Mental Performance and Sport Performance</b> .....	4
<b>Understanding the Concepts and Applying Them</b> .....	6
Reaction.....	6
Working Memory.....	8
Personality.....	10
Vision.....	11
Psychological Skills Training.....	13
Brain Endurance Training.....	15
<b>How Mind.Body.1. Approaches Mental Performance</b> .....	16
Top-Down Approach.....	16
Creating Drills Based on Science.....	17
Denominating.....	18
Fit-Rithmetic.....	19
Thought Squats.....	20
HecoStix Memory Catch.....	21
<b>Making it Make Sense For Your Population</b> .....	22
<b>Conclusion</b> .....	22
<b>About Mind.Body.1.</b> .....	22
<b>References</b> .....	24

## ABSTRACT

Approaches integrating mental training into athletic conditioning have started to spark interest from consumers resulting in an influx of companies, products, and technology applications aiming to improve an athlete's performance through mental performance training. The currently available techniques targeting mental performance include skill learning (i.e., breathing techniques, motivational coaching, etc.), products (i.e., reactionary light systems such as FitLight™, or hand-eye coordination tools such as HecoStix), or technology apps (i.e., cognitive tests or brain games such as BrianHQ). While these individual training components may be beneficial, a thorough understanding of the dynamic interplay between cognitive functions and mental performance is necessary for the development of effectively structured programs that will result in the greatest gains. This position paper will outline the core concepts of practical and scientific approaches to mental performance training with a strong emphasis on the key aspects of mental performance and how to integrate cognitive components into athletic training programs to promote consistent peak performance.

## INTRODUCTION

Elite athletes and their coaches are constantly searching for new methods to enhance performance and technological innovation has increased access to sophisticated technology and advanced training techniques now more than ever before. While athletic talent and perseverance are still essential components of overall sport performance, they are no longer sufficient to ensure high level athletic performance. Recently, there has been a new-found interest in the approach of targeting aspects cognitive and psychological in athletic training; however, application of this concept has been limited to clinical intervention provided via a sports psychologist or “game-like” technology applications. This position paper will introduce an approach that targets multiple aspects of cognitive and psychological performance while effectively engaging an athlete in their sport. Mind.Body.1.'s Cognitive C.O.N.D.I.T.I.O.N.I.N.G. method was developed through real-life practical training that was conducted with athletes in the psychological, physical,

and cognitive sectors over the last decade. This position paper will define and examine the key aspects of mental performance and describe possible methods to apply these aspects into training protocols for your athletes or yourself. We look to bridge the gap between athletic and mental performance to get your athletes mind right!

## MENTAL PERFORMANCE DEFINED

Mental performance is defined as the psychological and cognitive factors (i.e., executive functions) involved in an individual's ability to execute goal directed behavior. Simply put, how we think, how we process information, and how we manage emotional states influence how we perform. The ability to perform a specific task can be impacted by one's current psychological state, as if you are attempting to perform an action that is fueled with emotional undertones. For example, an athlete may miss a free throw and for the remainder of the game they linger on the emotional response to that missed free throw. The amount of mental energy spent focusing on the emotional response can result in their reduced ability to focus on other essential cognitive components throughout the remainder of the game. Given the impact of mental performance on overall sport performance, it is critical that training protocols include aspects of mental performance, such as techniques focused on the relationship between performance and how an athlete internally (subconsciously) processes information/thoughts. The position of Mind.Body.1.'s Cognitive C.O.N.D.I.T.I.O.N.I.N.G. method is based upon the notion that this dynamic interplay between psychological state and cognitive performance (i.e., executive functions) is the foundation of overall mental performance and this should be a key focus of athletic training approaches.

## INTERACTIONS BETWEEN MENTAL PERFORMANCE AND SPORT PERFORMANCE

Currently, athletic training approaches primarily focus on aspects of motor learning and performance with components of cognitive training (i.e., reaction time, decision making, etc.) to assist with performance enhancement. However, there has been little

investigation into how improving cognitive and mental capacities improves sport performance. Conceptually, an athlete's level of cognitive capacity is the foundation that sets up their ability to improve their athletic performance; thus, an increase in an athlete's foundational cognitive and/or mental capacity would lead to an increase in their athletic performance given a greater level of cognitive and/or mental functioning available to work with. Therefore, rather than addressing cognitive and/or mental capacity just as a factor of skill performance, targeting cognitive and/or mental capacity as its own domain that serves as the ultimate foundation for one's overall ability to improve skill performance may be the most effective and efficient approach to promote optimal sport performance.

Improvement in athletic performance has been traditionally addressed by having the athlete develop a variety of high-level skills related to their specific sport or focusing on strength and conditioning. Mental performance has often been approached differently, typically from a perceptual cognitive standpoint targeting aspects such as reaction time and decision making. These approaches usually involve an athlete being required to perform a physical motor movement in response to a stimulus (i.e., color, light). This approach is founded on the concept that if there is improvement in one's overall cognitive capacity, this improved cognitive functioning will ultimately transfer into the athlete's sports performance.

Recently, approaches integrating both cognitive and sport specific tasks have started being developed as a method to improve mental and sport performance. Instructing a basketball player to shoot a free throw every time a light flashes red and perform a layup every time the light flashes blue, would be an example of a drill that has the athlete practice a sport specific task while also targeting cognitive performance by requiring the athlete to use components of executive functioning (i.e., decision making, recognition reaction, working memory, etc.) to decide which task he should perform. Although this approach to mental performance training is an improvement, understanding how to structure an athletic training program so that it includes approaches that benefit both physical and mental performance is essential in order to achieve the most optimal result.

This becomes challenging because the training approach implemented will need to be adjusted to meet the requirements of the athlete's sport specific tasks, making a "one size fits all" approach nearly impossible (Hernandez-Mendo, et al., 2019).

## UNDERSTANDING THE CONCEPTS AND APPLYING THEM

The following is an overview of several psychological and cognitive concepts that can be implementing during various athletic training protocols to improve an athlete's performance. The list includes but is not limited to: reaction time, working memory, personality, vision, psychological skills training, and brain endurance.

### **Reaction Time**

Reaction time is the ability for an athlete to respond quickly when presented with a particular stimulus. By improving an athlete's reaction time, they will have more time to process other information and improve their ability to carry out a goal directed behavior/movement.

Research has found that athletes have faster reaction times when compared to non-athletes but interestingly there was no significant different in reaction time performance between athletic groups (Atan & Akyol, 2014). These findings suggest that reaction time must be an important component of athletic performance abilities and is not sport specific.

Reaction time tasks can vary in complexity based on the stimulus that is being presented. The following table outlines three different types of reaction time tasks (simple, choice, and recognition).

## Applications of Reaction Time

### *Simple*



One stimulus is presented and one response to act on (see a light then run). The quicker an athlete can attend to external factors in their environment the more time they will have to make a decision.

### *Choice*



Multiple stimuli are presented, and the response is based on which stimulus is the identified target. For example, if there were 4 red cones and 2 green cones and the coach calls out red, the participant only sprints to the red cones. Distinguishing between correct choices is imperative for athletic performance.

### *Recognition*



The stimuli presented is paired with specific cues that determine the appropriate response. For example, if an odd number is called out the athlete jumps but if an even number is called out they do nothing. In baseball and many other sports, it's important to only respond to relevant cues or it may result in poor outcomes.

(Raghavendra & Thangavel, 2014)

## **Working memory**

Working memory is the ability to simultaneously process information while engaging in another cognitive task. Being able to process information in the moment while still accessing stored memories is a factor in a variety of mental tasks. Consequently, working memory is a large factor in other cognitive and psychological processes.

In most sports, strength and power are considered important to improve an athlete's physical performance. Core lifts, such as the squat and bench press, are usually the foundation of an athlete's ability to demonstrate strength and power. Working memory can be compared to the physical core lifts; thus, increasing working memory load allows the athlete to focus, process task relevant information, and new information simultaneously in real time.

Working memory has a major role in sport due to the high cognitive demands and stress that athletes face, which can influence performance (Furley and Memmert, 2010). They also found that many individual differences amongst athletes were influenced by working memory. This can show how different traits and skills such as learning a new skill, decision making, focus, emotional control, and handling pressure are by products of working memory.

Often times when coaches speak of an athlete's awareness or intelligence, they are generally describing the concept of working memory. When they say things such as "He was able to read the defense and knew where to be" or "His focus couldn't be shaken", this is an example of working memory. The athlete isn't simply being in the right place, they were processing relevant information, weeding out what's unimportant and executing their sport specific task. The following table will breakdown the working memory model.



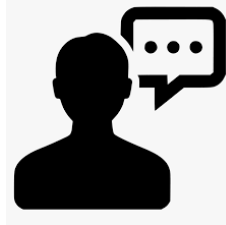
## Working Memory

### Central Executive



The central executive is like a CEO; It dictates what information needs to be attended to and what is deemed irrelevant or inappropriate for the presented task. An athlete can receive a large amount of stimuli at any given moment. Before they can react or make decisions, the central executive's job is to factor out what's unnecessary. Things such as screaming fans taunting the athlete would take away from task relevant cues and wouldn't need attention.

### Visuo-Spatial Sketchpad



The visuo-spatial sketchpad is how you can create a visual image of something to map out how it may look or be positioned. Think of it like the picture in picture feature for TVs. You mentally visualize a scenario to plan out or recall past events that have been previously seen. If a quarter back has three defenders charging at him, he must internally visualize what options he has to make the play while simultaneously processing what to do in real time.

### Phonological Loop



The phonological loop is where sound and language is stored. This is done by repeating given information so it can be applied. If someone gives you their phone number so you continuously repeat it in your head until you can save it in your phone. If the coach tells the athlete what they need to do for a play, the information will be replayed in the athlete's head until the task is executed.

Furley and Memmert (2010)

## Personality

Our behaviors influence our day to day living and this can affect how you perform in life and sport. Personality describes the set of traits and behaviors that influence our motivations, ambitions, performances and overall outlook on life. Understanding these traits can be beneficial to see how you or your athlete may engage with their surroundings and environment. Below is an over view of the Five Factor Model (Big-5). The acronym for the Big-5 model is OCEAN which stands for:

**O**pen to Experience

**C**onscientiousness

**E**xtraversion

**A**greeableness

**N**euroticism

Personality traits aren't dichotomic but rather occur on a spectrum of qualities. Studies have shown that at elite levels, athletes that scored high on conscientiousness and low on neuroticism saw greater levels of success (Allen and Laborde, 2014).

Trait	Description	Application
Open to Experience	More likely to try new endeavors especially more mentally stimulating.	When changes with the team happen, they maybe more receptive.
Conscientiousness	Prefers to plan and have clear cut goals.	May have goals to achieve consistent performance. May also be a perfectionist.
Extraversion	Has more comfortability in social situations and is more outgoing.	Large crowds aren't typically intimidating and can be motivating.
Agreeableness	Open to collaboration and working with others.	Team cohesion and coachability is more likely.
Neuroticism (want low score in this)	More likely to be anxious and worry about things even when not in their control.	More likely to let mistakes deter belief in their ability.

## **Vision**

Vision is one of several senses, but accounts for 80% of our external input is processed through visual means (Rayner, Smith, Malcolm, and Henderson, 2009). Vision isn't limited to the clarity of what your eyes can see. It also involves how your eyes perform and allow you to carry out life's physical and mental task. There are a variety of visual components such as: visual memory (recalling images seen in the past), saccades (rapid simultaneous eye jumps), peripheral (side view) and convergences (eyes moving toward a center point). When an athlete performs in their sport, visual cues will have a major effect on how they play. If the athlete has trouble with how their eyes process stimuli and convert it to goal directed behavior, they may have difficulties executing sport specific skills. In a study by Formenti et. Al, (2019) they found that vision training in volleyball players improved cognitive performance but not sport specific skills. While it is important to have general baseline of performance it can show how the appropriate setting is required to ensure the best possible chance of transferability to the athletes given sport.

As mentioned previously in this section, there are multiple components to vision and the table below will include a description of visual memory, saccades and peripheral vision.

## Vision

### Visual Memory



Visual memory is the ability to remember information that has been viewed in the past. If someone asks you for directions or to describe what someone looks like, a poor visual memory will make this difficult. If an athlete sees a play developing from one side then switches focus on the opposite side, they must be able to recall what they've previously seen. This will help them make correct decisions and recognize patterns.

### Saccades



Saccades are rapid movements of the eyes from point to another. When you are presented with a stimulus (let's say a light flashes) your eyes immediately jump to the flash to fixate on the image. Your head follows where the eyes go. Quickly changing your line of vision to track relevant stimuli can be the difference between a strike out or home run, missed passed or losing the game.

### Peripheral



Typically, we should have a span of 180 degrees (perceiving motion from the side). Peripheral vision isn't preferable for thoroughly seeing images but helps us detect things happening in or surroundings. If a defender is coming for a wide receiver and he can perceive them from their side view, then they can brace for impact or miss the defender altogether. An athlete must be aware of all their surroundings.

Rayner, Smith, Malcolm, and Henderson (2009)

## **Psychological Skills Training**

In sport, performing under pressure and keeping your composure is expected, yet often it isn't often emphasized in training. Psychological Skills Training can be beneficial to how athletes handle emotional stress and promote consistent peak performance. Psychological Skills Training (PST) refers to the systematic and consistent practice of mental or psychological skills for the purpose of enhancing performance, increasing enjoyment, or achieving greater sport and physical activity self-satisfaction" (Weinberg & Gould, 2007.). Psychological skills training can include skills such as goal setting, self-talk, breathing techniques and imagery (visualization). The objective is to be able to sustain peak performance even when faced with adversity, less than adequate scenarios and fatigue (physical or mental). Research has shown that implementing mental skills such as goal setting, self-talk, relaxation and stress management has shown improvement in physical fitness, self-esteem and confidence in school age athletes (Sheard and Golby, 2006).

When PST is implemented, it teaches the athlete to practice skills to help cope with challenges on a consistent basis so when they find themselves frustrated or stressed in sport or everyday life they can handle it efficiently. These resources contribute to the aforementioned working memory capacity theory in which stress and anxiety can negatively impact cognitive load to process and perform. The following illustrates a few concepts derived from PST.

## Psychological Skills

### Goal setting



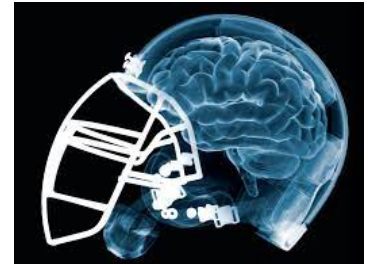
Typically, when athlete uses goal setting, the outcome (result) is usually emphasized. Things such as winning the game or make the team are targeted. There are different types of goal setting such as process goals where the athlete emphasizes the actions required to achieve an outcome. By focusing on what's necessary to perform, it can help with consistency and promote desired outcomes.

### Self -Talk



We have a dialogue in our head that influences our behavior. What we say can influences how we approach different task. Just like athlete training their muscles to grow, they can train what they say to be productive. If an athlete makes a mistake in a game and their immediate response is to say they suck or “ I can't do it”, then the tone is set for less than adequate outcomes.

### Imagery (Mental Rehearsal)

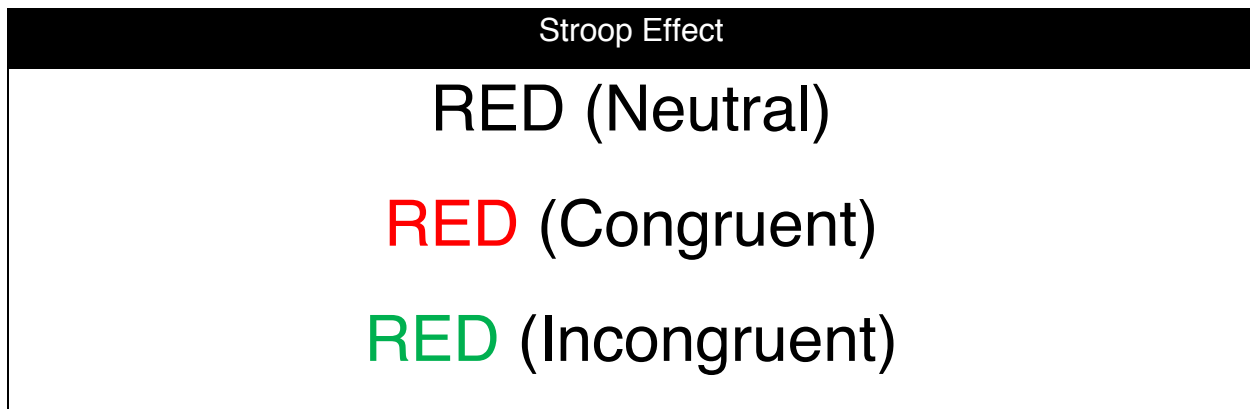


Visual representations in our head can have an influence on mental and physical performance. Seeing the action take places ignites a motor neuron response as if it's happening in real time. It can also help alleviate anxiety and worried by seeing the thoughts of worry or success play out and planning a reasonable plan of action to alleviate them. An athlete is limited to how much they can physically perform but visualizing in virtually unlimited.

Birrer, et. al., (2010)

## Brain endurance

Just as an athlete would be expected to physically perform for an extended duration of time on their sport, the same can be applied to mental endurance. Staying engaged for the entirety of a game or match is important to succeeding. There is a region of the brain called the anterior cingulate cortex (acc) that is located in the frontal lobe and is associated with perception of effort (Marcora, Staiano, and Manning, 2009). This means that if a person thinks they're physically tired they're more likely to succumb to fatigue. The goal would be to train these capacities with cognitive training methods that affect the same regions. Task such as the Stroop effect have been implemented to address these mental capacities.



The Stroop effect involves a color spelled out and the ink the ink of the word matching (congruent) or not matching (incongruent). The goal of this task is to ignore what the written word says and react what the color of the ink is. The Stroop Effect involves inhibition control and that is located in the frontal lobe. The frontal lobe is where executive functions are housed and cognitive task such as the Stroop Effect can be done over a prolonged duration of time (e.g., 1, 5, 10 minutes) to improve resistance to mental fatigue.

According to Staino (2015) an increase in aerobic output was seen in athletes who performed cognitive training as opposed to the group that didn't. This means that as the duration of mental effort increased the participant was able to tolerate more physical pain or fatigue. These implications can also be applied with the combination of physical

training, for example, running on a treadmill while completing a cognitive task. With combination of these two tasks the mental and physical fatigue are challenged so the athlete can adapt to both.

Another consideration with brain endurance training is the inner thoughts that must transpire while performing an elongated cognitive task. While being mentally engaged to execute the cognitive task, the monotony can lead to irrelevant thoughts and dialogue internally. This gives the athlete a chance to practice self-talk skills and focus.

## HOW MIND.BODY.1. APPROACHES MENTAL PERFORMANCE

The following section demonstrates how Mind.Body.1. applies their methods to their elite level and youth athletes. Applications of the science from the previous sections will be shown via actual drills that have been used by athletes of all levels.

### Top-Down Approach

In sport the emphasis on how an athlete physically performs is the ultimate goal. Regardless of the method(s) used to hit a ball further, shoot a basketball more effectively or run faster, the coach and athlete wish to see the desired outcome. As previously explained, the concepts of implementing cognitive and mental skills can be beneficial to athletes.

Mind.Body.1.'s approach targets the mental components first, so they lead to a goal directed behavior rather than simply moving around and then adding a mental cue. This means targeting a mental process such as decision making and having the participant dictate their response based on what they perceive. For example, there are drills where an athlete may use an apparatus or ball that's from their respective sport, such as a soccer ball and kick it around until given a mental cue. Our approach would involve the mental cue (such as an equation) to be solved in order to execute the physical task. This doesn't mean that we don't include methods that involve sport related task or tools, but

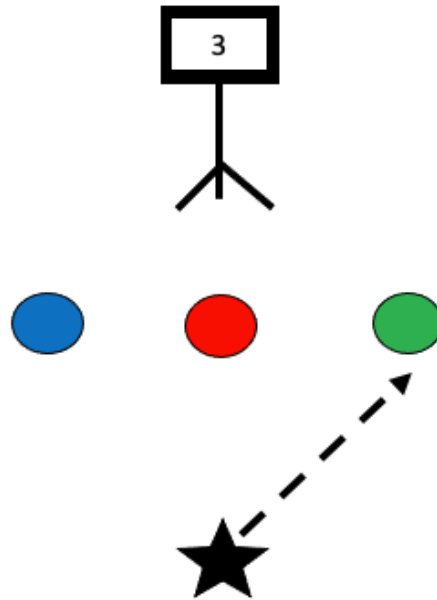


we rather emphasize the psychological/cognitive concept first. The overall goal is to allow the thinking aspect of performance to carry a majority of the load rather than the physical. The rationale for this is that we know the athlete will spend plenty of time in their respective sport doing position specific work, so as not to physically over load them and interfere with sport specific mechanics, we have the mental load lead the way. The amount of combining physical and mental stimuli can be adjusted based on task difficulty and training objectives.

## Creating Drills based on the Science

The following drills will demonstrate an application of the concepts that were covered as they apply performing in sport. Some can be done without any special equipment and others may contain additional tools such as HecoStix.

## Denominating



**Description:** Here you assign numerical value, words, letters or symbols to exercise movements or (colored) cones. For example, a red cone will symbolize 1, blue cone symbolizes 2 and green symbolizes 3. The participant would have to react to the number called and correlate it to the associated color. This drill can be done with someone calling out the cues or a digitized program that flashes numbers or relevant stimuli.

**Rationale:** By using a different cue not directly associated with color (i.e., numbers) to represent the desired response, working memory is primarily targeted. The extra step in processing will create a slight delay in response. This increased mental load is to get the participant to adapt to making decisions properly before performing the goal directed behavior.

**See Video Here:** <https://youtu.be/2ntkl1OjLGQ>

### Fit-Rithmetic

**Description:** Fit-Rithmetic is a form of denominating that requires participants to perform some type of mathematical equation while completing a specified task or exercise. For example, using the example from the denominating section (red=1 blue=2 green=3) the equation  $4-2=2$  so you'd sprint to the blue cone. This drill can also be used as shown in the picture with visual cues to dictate the equation.

**Rationale:** This is a progression of denominating that uses more cognitive load before making a goal directed behavior. When processing stimuli in sport there will be a number things to focus on and in this drill the objective is to quickly compute the equation and perform the appropriate response.

See Video Here: <https://youtu.be/Mo4jE1qjRN0>

## Thought Squats



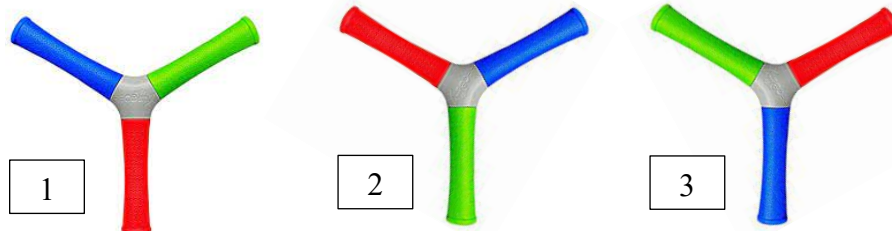
### Don't think about : Green Pickles”

**Directions:** This drill works on self-talk and focus. Have the athlete partner up with another individual and have the partner choose a target word to not think about. Time the drill for a minute and in that time frame the participant is to verbalize and speak out loud whatever comes to mind and they are not think about their given word. If they do think about the given word, they perform a squat. The goal is to perform as few squats as possible in the given time.

**Rationale:** Unwanted thoughts can intrude in our minds. This drill deals with how we can control them and keep unwanted or irrelevant thoughts out our head. An athlete must be able to perform effectively and if things don't go their way, they must be able to refocus and keep their mind on track.

See Video Here: [https://www.instagram.com/p/CBG7v6Jjxdn/?utm\\_source=ig\\_web\\_copy\\_link](https://www.instagram.com/p/CBG7v6Jjxdn/?utm_source=ig_web_copy_link)

### HecoStix Memory Catch



Call Number: “2” participant catches Green

**Directions:** The athlete partners up or works with the coach using the HecoStix tool. The participant stands a few feet from the partner and the partner flips the HecoStix three times. Each time they flip it, the participant focuses on which colored side is caught. After the three flips the partner calls out a number (1, 2 or 3) and throws it to the participant and they catch the color based on the order flipped. For example, in the above image the order of flips was red, green the blue. If the partner called two before throwing the HecoStix the participant would catch the green leg.

**Rationale:** This drill involves visual aspects such as visual memory and working memory. The participant must track the HecoStix and catch it. This is applicable to sports that rely on catching and hand-eye coordination. Also, because the catch is determined by focusing on remembering color order it puts a higher cognitive load to complete while executing the physical parameters.

See Video Here: [https://www.instagram.com/p/CNSXykJBHaL/?utm\\_source=ig\\_web\\_copy\\_link](https://www.instagram.com/p/CNSXykJBHaL/?utm_source=ig_web_copy_link)

## MAKING IT MAKE SENSE FOR YOUR POPULATION

When implementing any of the aforementioned concepts it's important to think how it applies to you or your athletes. When considering the applied skills such as reaction time, vision, or personality, think of what components of your given sport can fit. For example, when noticing performance issues with an athlete, you can consider personality traits before attributing to solely being because of lack physical ability. Maybe the player deals with criticism better when not in front of the team (extraversion). This can aid in finding the root cause of the problem. Some may attribute the athlete to not being mentally tough, but they may have needed a private approach to be coached. Mental toughness is often talked about in sport but how does a coach or athlete rate this? According to Yankov, Davenport and Sherman (2019) personality measures such as extraversion, conscientiousness and emotionality (neuroticism) could predict mental toughness in athletes. Regarding cognitive demands, the coach or athlete can take into consideration what type of reaction they wish to use instead of just applying one approach. Understanding how to manipulate these variables is the first step learning how to improve mental performance in a way that can contribute to success.

## CONCLUSION

Overall, this paper was intended to be an introduction into the world of mental performance and isn't meant to be an exhaustive list of methods. There is more in-depth literature for the specific concepts. We combined the chosen concepts to demonstrate actual methodology that has been used for nearly the last decade with some of the top athletes and performers. Readers should have a general concept of key concepts to approach their athletes training and development from a variety of angles. There are many aspects that make up mental performance and there is no right or wrong method. The overall objective should include understanding general concepts to give a baseline level of knowledge when implementing with your respective population.

## ABOUT MIND.BODY.1.

Mind.Body.1. is a company that creates solutions for mental performance in a variety of populations. The demographics we serve range from academic populations (Education K-12), Tactical (military, law enforcement), corporate wellness, athletics, active aging and addiction population. We use a method we've developed called Cognitive C.O.N.D.I.T.I.O.N.I.N.G. This protocol implements a multifaceted approach to educate, train and improve performance. When we refer to performance this can mean physically, academically, socially, mentally, emotionally, and even financially. In short, the overall mission is to strive for you to perform to your highest ability regardless of levels of stress, lack of resources or preparedness through heightened cognitive performance.

**Learn more about our methods and how we help the world's top athletes, soldiers, coaches, educators and businesses improve mental performance.**

[www.themb1.com/mb1course](http://www.themb1.com/mb1course)

@themindbody1

@mrmentalmuscle

[info@themb1.com](mailto:info@themb1.com)

954-226-2926

## REFERENCES

Allen, M. S., & Laborde, S. (2014). The role of personality in sport and physical activity.

*Current Directions in Psychological Science*, 23(6), 460-465.

doi:10.1177/0963721414550705

Atan, T., & Akyol, P. (2014). Reaction times of different Branch athletes and correlation

between reaction time parameters. *Procedia - Social and Behavioral Sciences*,

116, 2886-2889. doi:10.1016/j.sbspro.2014.01.674

Birrer, D. D., & Morgan, G. G. (2010). Psychological skills training as a way to enhance

an athlete's performance in high-intensity sports. *Scandinavian Journal Of*

*Medicine & Science In Sports*, 2078-87. doi: 10.1111/j.1600-0838.2010.01188.

Formenti, D., Duca, M., Trecroci, A., Ansaldi, L., Bonfanti, L., Alberti, G., & Iodice, P.

(2019). Perceptual vision training in non-sport-specific context: Effect on

performance skills and cognition in young females. *Scientific Reports*, 9(1).

doi:10.1038/s41598-019-55252-1

Furley, P. A., & Memmert, D. (2010). The role of working memory in sport. *International*

*Review of Sport and Exercise Psychology*, 3(2), 171-194.

doi:10.1080/1750984x.2010.526238

Grrishma Balakrishnan, Gurunandan Uppinakudru, Gaur Girwar Singh, Shobith

Bangera, Aswini Dutt Raghavendra, and Dinesh Thangavel, "A Comparative

Study on Visual Choice Reaction Time for Different Colors in Females,"



Neurology Research International, vol. 2014, Article ID 301473, 5 pages,  
2014. <https://doi.org/10.1155/2014/301473>.

Ilkowska, M., & Engle, R. W. (n.d.). Working Memory Capacity and Self-Regulation. *Handbook of Personality and Self-Regulation*, 263–290. doi: 10.1002/9781444318111.ch12

Jerath, R., Crawford, M. W., & Barnes, V. A. (2015). Functional representation of vision within the mind: A visual consciousness model based in 3D default space. *Journal of Medical Hypotheses and Ideas*, 9(1), 45–56. doi: 10.1016/j.jmhi.2015.02.001

J.F. Hejtmancik, P. Cabrera, Y. Chen, O. M'Hamdi, J.M. Nickerson,  
Chapter 19 - Vision, Editor(s): P. Michael Conn, Conn's Translational Neuroscience,

Academic Press, 2017, Pages 399-438, ISBN 9780128023815,

<https://doi.org/10.1016/B978-0-12-802381-5.00031-2>.

(<http://www.sciencedirect.com/science/article/pii/B9780128023815000312>)

Leisman, G., Moustafa, A., & Shafir, T. (2016). Thinking, Walking, Talking: Integratory Motor and Cognitive Brain Function. *Frontiers in Public Health*, 4. doi: 10.3389/fpubh.2016.00094

MacNamara, Á, Button, A., & Collins, D. (2010). The role of psychological characteristics in facilitating the pathway to elite performance Part 2: Examining

- environmental and Stage-Related differences in skills and behaviors. *The Sport Psychologist*, 24(1), 74-96. doi:10.1123/tsp.24.1.74
- McEwen, S. C., Siddarth, P., Abedelsater, B., Kim, Y., Mui, W., Wu, P., ... Small, D. A. (2018). Simultaneous Aerobic Exercise and Memory Training Program in Older Adults with Subjective Memory Impairments. *Journal of Alzheimer's Disease*, 62, 795–806. doi: DOI 10.3233/JAD-170846
- Nieman, D. (2010). Mental fatigue impairs physical performance in humans. *Yearbook of Sports Medicine*, 2010, 145-146. doi:10.1016/s0162-0908(10)79655-0
- Purves D, Augustine GJ, Fitzpatrick D, et al., editors. Neuroscience. 2nd edition. Sunderland (MA): Sinauer Associates; 2001. Types of Eye Movements and Their Functions. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK10991/>
- Rayner K, Smith TJ, Malcolm GL, Henderson JM. Eye Movements and Visual Encoding During Scene Perception. *Psychological science*. 2009;20(1):6-10. doi:10.1111/j.1467-9280.2008.02243.x.
- Schmeichel, B. J., Volokhov, R. N., & Demaree, H. A. (2008). Working memory capacity and the self-regulation of emotional expression and experience. *Journal of Personality and Social Psychology*, 95(6), 1526–1540. doi: 10.1037/a0013345
- Sheard, M., & Golby, J. (2006). Effect of a Psychological Skills Training Program on Swimming Performance and Positive Psychological Development. *International Journal of Sport and Exercise Psychology*, 4(2), 149–169. <https://doi.org/10.1080/1612197X.2006.9671790>

- Slimani M, Miarka B, Briki W, Chéour F. Comparison of mental toughness and power tests performances in high-level kickboxers by competitive success. *Asian J Sports Med* 2016;7:e30840.3.
- Renshaw, I., Davids, K., Araújo, D., Lucas, A., Roberts, W. M., Newcombe, D. J., & Franks, B. (2019). Evaluating weaknesses of “perceptual-cognitive training” and “brain training” methods in sport: An ecological dynamics critique. *Frontiers in Psychology*, 9. doi:10.3389/fpsyg.2018.02468
- Rogers, Tracie & Alderman, Brandon & Landers, Daniel. (2003). Effects of Life-Event Stress and Hardiness on Peripheral Vision in a Real-Life Stress Situation. *Behavioral medicine (Washington, D.C.)*. 29. 21-6. 10.1080/08964280309596171.
- Weinberg RS, Gould D (2007). *Foundations of sport and exercise psychology*. Champaign, IL: Human Kinetics.
- Yankov, G. P., Davenport, N., & Sherman, R. A. (2019). Locating mental toughness in factor models of personality. *Personality and Individual Differences*, 151, 109532. doi:10.1016/j.paid.2019.109532