Neurology and bowling

What brain research tells us about skill acquisition and effective practice

In the past decade, an explosion of recent findings in the field of neurological research has revealed significant insights into how our brain works. These new findings often contradict conventional wisdom about mental development and structure. No more does the conception that our brain is a static entity after childhood hold true. Rather, the brain doesn't realize full development until an individual is in their twenties. It remains dynamic and evolves after this point as we have new experiences and learn new skills.

Through the neurological findings of the last decade, it has been realized that the brain is a dynamic system that restructures itself when individuals learn new skills, regardless of age. Within this body of work, there have been significant findings on the impact of neurology on skill acquisition. From myelenation to mirror neurons, your brain plays a significant role in skill acquisition, development, and mastery.

In this month's Slowinski at-large, I share with readers some of the most important findings

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in neurology as well as the impact these findings have on effective learning and skill acquisition. In closing, I provide readers with a practice process to maximize skill development.

Skill acquisition and brain development

When learning new skills and practicing, research has shown that the brain will actually restructure itself and expand. With new experiences and learning, research has shown that our grey matter increases. Grey matter consists of regions of the brain that process sensory, motor stimulus, and physical movement.

In 2004, Dr. Bogdan Draganski and his colleagues revealed that as people learned a new skill, their grey matter increased by three percent over a three month period. Participants were both taught juggling and practiced juggling during this time. The actual process of learning a new motor skill increased their brain capacity as they developed the new skill. After stopping, the volume of grey matter actually decreased to an overall improvement of two percent from the pre-study period. Stopping practice led to a decrease in grey matter.

In Architecture of the Golfer's Brain, Jëncke and colleagues mapped the brains of skilled and less skilled golfers. The highly practiced skilled golfers had more grey matter than the less skilled and less practiced golfers. Following up on these findings, researchers at the University of Oxford (Oxford Centre for Functional Magnetic Resonance Imaging of the Brain) studied the amount of white matter after training. One group of 12 participants was taught juggling for six weeks and asked to practice 30 minutes each day. The other 12 participants did not learn or practice juggling at all during the six weeks. These individuals did nothing different than before. The white matter of both groups was measured before and after with a diffusion MRI. After six weeks, the group that was training and practicing showed increases in white matter.

White matter consists of nerve fibers (axons) which are surrounded by myelin, a type of fat, which gives it the whitish color. The myelin sheath is important as it acts as an insulator around the nerves increasing the speed of transmission between axons.

The research demonstrates that training and acquiring new skills leads to faster biomechanical processing power in the brain. When participants stopped training, these increases depleted. These findings demonstrate that training has a major impact on skill acquisition through increasing grey and white matter. A lack of training leads to a decrease in grey and white matter.

Bowler see, bowler do

Mirror neurons were discovered accidentally by Neuroscientist Giacomo Rizzolatti of the University of Parma in the late 1980s. Rizzolatti and his colleagues were investigating brain activity in the F5 region of the brain during movement. When a monkey saw the scientist pick up a peanut, the motor neuron in the monkey's brain fired exactly in the same manner as when the monkey actually reached out and grabbed the peanut. In a 1996 research paper, the scientists first dubbed these motor neurons mirror neurons. Literally, the same part of a brain is activated when we do something and when we observe someone doing that same activity.

Researching this phenomenon further, Dr. Daniel Glasser and his colleagues conducted a study to determine if experience and skill had an impact on the quality of neuron firing. In this study, Glasser and colleagues studied non-

dancers, ballet dancers, and capoeira dancers. Capoeira is a dance form incorporating martial arts elements. The research revealed that expertise of a specific skill led to a stronger firing of the mirror neurons when the expert viewed other experts doing the same motions they could do. Specifically, the ballet dancers' mirror neurons fired more when viewing ballet. Capoeira dancers mirror neurons fired more when viewing capoeira. Interestingly, the capoeira dancers had a stronger firing when viewing ballet compared to the non-dancers and the ballet dancers had a stronger firing when viewing capoeira compared to non-dancers. Skill acquisition is linked with mirror neuron strength.

As discovered, mirror neurons fire both when you engage in physical motor movement and when you see this same movement in others. Whether seeing or doing, the mirror neurons fire. This yields the importance of observing efficient professionals who exhibit biomechanical efficiency. This is a system of kinematic/motion acquisition and observation reinforcement. As your physical skill improves, the mirror neurons should fire with greater intensity, reinforcing the improved skill acquisition.

Imitation and mimicry have always been important in sports such as the martial arts and elite sports. Children see professionals often on television and attempt to imitate them. With the powerful findings associated with mirror neurons, we can proceed with viewing top players with more purposefulness in regard to training.

The implication of mirror neurons and skilled acquisition is that watching world class bowlers on an ongoing basis will help sustain and build skill acquisition. This is a linkage of physical movements. As your skill and biomechanical efficiency improves, mirror neurons will support, sustain, and improve physical movement.

Infusing brain research into effective bowling practice techniques

With such exciting neurological research findings, it will benefit our sport to utilize this information to train more effectively. Accordingly, I present three specific training techniques to maximize putting the neurological findings into practice. These include: a skill drill sequence, ambiguity training, and mirror neuron activation.

Skill Drill Linkage

At the Kegel Training Center, we have developed a four-step drill process that is designed to link the most effective biomechanical movements into an efficient full approach. By doing each drill, your body and brain are developing the skills needed to have a biomechanically smooth and efficient physical game. The from-the-foul-line-backward approach for drill sequence helps to acquire the micro skills of each position throughout the entire approach.

Foul Line

The foul line drill places the body in the finish position and provides a physical feeling for where the body, arm, and hand should be at release. In setting up to execute the drill, the ball should go next to the foot about ½ inch away. Set the slide foot first and then position the slide leg. The ball-side knee should be inside the slide knee, relaxed, and bent. Put your index finger and forearm straight and facing toward the pins. The inside of the elbow should be inside the wrist from a vertical perspective. (See photo)

To execute, the bowler should cup the ball slightly by moving the index finger under the ball. Move the ball approximately six to eight inches forward, swing it 12 inches back from this position, swing it forward again, and release the ball.

The hand should rotate around the ball as you extend shin high to promote a down the lane motion rather than lifting. Keep the forearm facing forward when releasing the ball. It should remain under the nose the entire time. (to view the video, go to www.bowlingthismonth.com/extras)

Swing and Slide

The swing and slide drill builds swing efficiency as well as torso rotation into the finish. It links the slide into the finish position. I wrote a complete description of this drill in the December 2008 issue of BTM. *Introducing the Swing & Slide Drill* is also available at www.bowlingknowledge.info in the physical game section.

3-Step

The three-step drill is designed to replicate a hinge movement (swing start) as well as great timing from the top of the swing into the finish. I wrote a detailed article on the hinge including the 3-step drill in *Hinge It to a Better Physical Game*, in the February 2009 issue of BTM. This article is also available at www.bowlingknowledge.info in the physical game section.

Backup

The backup drill is designed to replicate a world class swing and hand position into the finish. For a detailed description, please read *Improve Your Swing & Release* in the March 2009 issue of Bowling This Month. This article is also available at bowlingknowledge.info in the physical game section.

Ambiguity Training

As the study of jugglers illustrates, learning a new skill such as adjusting ball speed or changing axis of rotation leads to an increase in the grey and white matter in your brain. As you acquire new skills, your brain will increase in both grey (processing) and white (connection speed) matter. Specifically, in the training session you want to push your skill limits and challenge yourself to do new things. These include learning ball speed and release changes. The easiest way to accomplish this is by playing the lanes in different places, or with a ball that doesn't match up with the pattern. By forcing yourself to hit the pocket with bad ball reaction or from different angles with bad ball reaction, you will acquire new skills in altering ball reaction.

Try hitting the pocket from different zones such as outside the first arrow as well as over the second, third, fourth, fifth, and sixth arrows. To hit the pocket consistently will require ball speed and axis of rotation changes. Stay in each zone until you can hit the pocket with 20 consecutive throws. This ambiguity training will force you to learn ball speed and release changes.

Mirror Neuron Activation

Mimicry and imitation is actually made possible with mirror neurons. Before these findings, we believed this to be an external process. Yet, with these findings, we know that neurons in the same region are fired as if we were doing the physical task ourselves. Accordingly, a daily training process of watching elite bowlers should be part of every bowler's training. As you watch your mirror neurons will fire, reinforcing your physical game training. YouTube is a great resource for watching the best physical games in the world such as those of Chris Barnes, Tim Mack, and Pete Weber.

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Closing thought

Becoming an elite bowler takes 10,000 hours of training. There are no short cuts. Neurology research demonstrates that focused training can lead to improvement. It also demonstrates why a bowler needs 10,000 hours of training to reach their full potential. By doing both targeted physical game training through drills, ambiguity training, and watching elite bowlers on video each week, you will take your game to the next level. Watch the videos with a critical eye. How are the body angles? What is the footwork doing? Where is the arm relative to the wrist and body? What is the timing of these bowlers? Watch for at least 30 minutes each day as part of your training.

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