HUMAN PHYSIOLOGY OF DRIVING

1. Reactions: stimulus, processing, response.
    1. Basic vs. complex reactions.
    2. Stimulus.
        1. Basic structure and function of neurons.
        2. Physiology of vision.
            1. Ocular function.
            2. Visual cortex.
            3. Basic mental processing of visual stimuli.
        3. Physiology of auditory system to include vestibular complex.
    3. Processing.
        1. Basic theory of human thought.
        2. Neurophysiology of habits.
        3. Balance and coordinated movements.
        4. Impact of global mental state (confidence, fear, happiness, uncertainty, etc.)
        5. Conscious vs. subconscious.
    4. Response.
        1. Basic neuromuscular physiology.
            1. Muscle contraction.
            2. Recruitment.
            3. Muscle energy consumption (aerobic vs. anaerobic).
            4. Fatigue.
            5. Impact of global mental state.

2. Theories of muscular training and adaptation.
    1. Aerobic vs. anaerobic.
    2. Action specific training.
    3. Stimulus, adaptation, and recovery.
    4. Periodization.

2. Application of physiology to driving.
    1. Stimulus.
        1. Visual vs. vestibular.
        2. Maximizing the input sensitivity.
            1. Application of visual geometry in real space.
    2. Processing.
        1. Directed practice.
        2. Conscious to subconscious.
        3. Effects of global mental state.
    3. Response.
        1. Application of training methodologies.
        2. Creating a personalized training plan.
        3. Techniques for successful implementation of a plan in the real world.

EXAMPLE OF LEARNING MATERIAL: REACTIONS AND HUMAN PHYSIOLOGY OF DRIVING

Driving is a reaction-based sport, in contrast to a more fitness-oriented sport such as running. Drivers react to where they are on track, what the car is doing, and what is going on around them. They need quick reactions, but those responses are very specialized. First, let's look at what a reaction is on a fundamental basis.

A reaction has three parts: stimulus, processing, and response. Think about one of the most basic reactions, where the doctor taps your knee with that little hammer and your leg kicks up (called a deep tendon reflex). The stimulus is sensory neurons detecting stretching in the tendon below your knee cap (your patellar tendon). The processing is nothing more than the sensory nerve directly exiting a motor nerve in your spinal cord. And the response is that motor neuron exiting your quadriceps muscle in your thigh to contract, causing the kicking motion. Tap, kick.

Though we are all every different people, the things that we are made up from, like proteins, and all identical, down to the molecules. The various proteins in the nerve cells in one person's body are not just similar to those in another's, they are absolutely identical, built from the exact same DNA blueprint. Our differences are in things like the skeleton and muscles themselves, which vary from person to person. The stronger the muscle is, the bigger the kick, so strengthening the muscle can affect the response phase. But the nerves that control all of this are exactly the same; it's all in how you use them, and that can all be trained.

A deep tendon reflex is an example of the most basic type of reaction, one that does not include any direction from your brain. Doctors use it to test how well the systems involved are working (sensory nerves, motor

nerves, skeletal muscle). These things are analogous to the wiring loom in a car. Assuming they are working as they should, the time it takes for this process to occur is constant, and try as you might, you cannot speed it up – you can't practice deep tendon reflex responses and make them faster.

Now consider the other end of the spectrum: a word problem needing a written answer. Here, the stimulus is the written question, which requires our brain to see and interpret the text. The processing is our brain analyzing the question and determining an answer. The response includes the brain directing the words of the answer and the actual motion of the pen to make the letters.

This example is much more complex, but take a minute and think about how much of that process is streamlined by your brain. You don't look at each individual letter. Instead, you take in entire words, sometimes entire phrases or even sentences. You compare what you are given with past experience. What kind of question is it? Have you heard something like this before? How did you respond and was it the right answer? Do you need to know more, or calculate anything? Is there a trick hiding in the wording? The response is also streamlined, as we certainly don't consider the way we need to hold the pen or form the letters, we just write it down. So, our past learning and experience plays an enormous part in the process. To someone who has not learned to read or write, this is an impossible task. But we know that being illiterate in no way means you are incapable of reading and writing, only that you haven't learned.

Now consider something more in the middle: the center on a basketball team, defending against the sudden mover of an opponent with the ball at the top of the key. Here, he is processing an enormous amount of information, but it is all subconscious. He is aware of the other players

around him, how they are interacting, where they are moving, and where openings are forming or being shut. He cannot simply watch the ball, but must instead look for cues in his opponent, where he is leaning, where he is looking, where he is carrying his weight. When the other player starts to move, there is no time for mistakes: he must predict what his opponent is going to do, or he will be left in the dust. There is no time for conscious thought, it must all be "instinct." The reaction requires trained visual input, a coordinated neuromuscular response, and strong muscles to carry out the intended movement.

In situations such as this, it appears to a fan in the stands that the player has lightning-fast reflexes, because a good player is already in motion before someone with less experience even knows what is going on. But that is not dependent on the speed of the reaction, it is earlier recognition of the situation and earlier and more precise initiation of movement. We are all basically the same physiology – remember, you can't speed up the wiring loom. But experienced players have the ability to read the game, so that they are moving before someone less experienced even knows what is going on. It is chess at full-speed. On top of that, expert players have trained the response phase: their movements are strong, coordinated, efficient, and precise.

How important are the different phases? Consider one more example: tennis. Tennis is very physical, requiring excellent speed and agility. And yet an experienced tennis player who is out of shape will still easily beat even the fittest person who doesn't know the game. That gives you an example of the importance of the stimulus and processing phases: reading the other players movements and anticipating where the ball is going, knowing the best placement for a return hit without having to think about it, and executing that return. Just like racing, experience

trumps fitness. But any tennis player's game will suffer as they fatigue. Some balls will be too far out of reach, some returns not as fast or precise. And this is where fitness comes back into play, because when skills are evenly matched, the one with the strength and stamina to continue performing at their highest level will come out on top. And this is why to be truly elite in any discipline – including driving – you have to be in top physical condition. As a driver, if you are not fit, you are leaving speed on the table.

So despite their vast differences, these examples are fundamentally all the same: stimulus, processing, response. And when we talk about improving driver reactions, this is what we are talking about. The experienced driver has mastered all three phases. To the untrained eye, this appears to be just short of magical, but it is not; it is simply learning to recognize the stimulus, processing the information, and responding appropriately.

So, to understand what we can all do to drive to the best of our ability, we break down each phase, evaluate what is going on, and consider how best to improve upon our current skill.

If you are a racer, the words "seat time" probably just passed through your head. In the racing world, seat time is practice. But like any other sports, the way you practice is extremely important. Practicing correctly leads to improvement, practicing incorrectly leads to developing bad habits. And at every level of racing – especially for the amateur – seat time is limited. Which means there is much more time for training outside the car. The trick is to make the best use of that time, because the real limit on how good you can become as a driver is time.

Stimulus, processing, response.