Motor Learning Project

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In summarizing my experience in teaching a motor skill it is first important to define what a skill is, and Guthrie (1952) states it as “the ability to bring about some end result with maximum certainty and minimum outlay of energy, or of time and energy” (Schmidt & Lee, 2020, p.5). It is also imperative to determine a goal for performing a skill and a ten second handstand hold was chosen while focus was placed on it being held consistently, carried out on demand, and with conserving energy expended while inverted (Schmidt & Lee, 2020). Minimizing the amount of energy required is essential as there is high physiological and psychological energy cost required to hold a handstand, and it will be also important to achieve the hold quickly to minimize fatigue (Schmidt & Lee, 2020). According to Schmidt & Lee (2020) the handstand skill is considered *closed* as the environment is stable and predictable while classified as *discrete* in that there is an easily defined beginning and end (kick to handstand, hold for 10 seconds, kick down). As *discrete* skills require processing in a stable and predictable environment, the opportunity for automaticity can be achieved where the participant will process information quickly without conflict from other processing efforts (Schmidt & Lee, 2020). These factors are necessary to first identify then classify for optimal teaching design.

The next step would be in identifying the different processing stages during each component of the movement controlled through open-loop (non-feedback) and closed-loop (feedback) processing (Schmidt & Lee, 2020). The first stage in the model is the input stage where the participant processes the information that will be needed to perform the handstand (Schmidt & Lee, 2020). The stimulus identification stage continues with the participant receiving the information from the senses and selecting important information, the response selection stage then decides the process of how the handstand will occur, and in the response selection stage the participant will retrieve and organize a handstand motor program (Schmidt &

Lee, 2020). These first three stages then lead into motor programming to the spinal cord and muscles that produce movement and would be represented in an open-loop model representing the kick-up portion of the handstand as it is a quick action that lacks time for processing feedback errors to supply the corrections needed (Schmidt & Lee, 2020). Since the fast motion kick-up needs to be organized ahead of time and performed without sensory feedback, this open-loop model would allow the motor system to organize the kick-up without having to rely on slower information processing like the closed-loop model relies on (Schmidt & Lee, 2020). The closed-loop model would be more appropriate in the handstand hold as consistent posture is needed while maintaining position of the limbs in relation to the body while inverted (Schmidt & Lee, 2020). Along with the open-loop processes described prior, the closed-loop processes contain exteroception feedback (supplies visual feedback in the handstand), proprioceptive feedback (feedback about body posture while inverted), M1 & M2 (reflex mechanisms that modify actions quickly and automatically due to positional changes), anticipated feedback (based on past handstand practice), dorsal vision (information regarding the entire visual field while inverted), and the comparator (compares feedback from motor output and anticipated feedback to interpret errors) (Schmidt & Lee, 2020). The closed-loop feedback mechanism will compensate for errors in the handstand position (medial-lateral or anterior-posterior sway) from the comparator and then sends the error signal back to the stimulus identification stage to start the process again (Schmidt & Lee, 2020).

Memory systems will further enhance understanding in teaching a handstand and include short-term sensory stores where sensory information is absorbed through visual cues (spotting the ground while approaching the handstand) that are briefly retained for one second (Schmidt & Lee, 2020). The short-term memory is the participants “working memory” of prior history of performing handstand attempts that servs as a temporary storage space for the information (Schmidt & Lee, 2020). Long-term memory is where the participants motor skill movements for sport are retained for long periods of time and are connected through other senses (Schmidt & Lee, 2020).

Success in a handstand skill will be greater achieved with the ability to sense the movements of the joints and tension in muscles that is described through having proprioception of body movements (Schmidt & Lee, 2020). Gaining understanding of one's body movements will give information about the condition of the body parts in relation to each other and the environment through the central nervous system's complex processing of inputs from joint receptors, muscle spindles, Golgi tendon organs, and cutaneous receptors (Schmidt & Lee, 2020). This proprioceptive information will be important in detecting sway and loss of stability that threatens maintaining balance during a handstand (Schmidt & Lee, 2020). A study conducted by researchers Sobera et al., (2019) suggested that experienced participants produced less medial-lateral and anterior-posterior body sway and showed more control over body position compared to less experienced participants while holding a handstand. This study inspired the participants baseline and five-week force plate handstand hold with the goal of producing better postural control and advanced processing capabilities in open and closed-loop systems. Vision also plays an important role in balance control for postures like a handstand where the goal is to remain as motionless as possible with the visual system signaling tiny corrections to hold the handstand steady (Schmidt & Lee, 2020). Postural regulation benefits from expertise in skills like a handstand are due to the requirements of fine motor skills and have been shown to produce a positive influence on postural regulation (Gautier et al., 2008). Comprehension in fine motor skills enabled the participants in the study from Gautier et al., (2008) to react rapidly after destabilization and shows that postural experience can increase the ability to coordinate and regulate posture. According to Schmidt & Lee (2020) setting realistic, reasonably achieving, and specific goals for continued motivation and challenge for the participant will help to obtain handstand competence for balance control aiding in fall prevention.

Creating an external focus of attention (pushing down into force plates) is more ideal for performance as it utilizes the dorsal visual pathway that focuses on movement control rather than an internal focus of attention (wrist and arm position) that utilizes the ventral visual pathway in object identification (Wulf, n.d.). Focusing externally will also create a more automated control process for faster, more accurate, and fluid movements instead of consuming energy by constricting motor muscular contractions when focusing internally (Wulf, n.d.). An external focus of attention (EF) is also contained in Wulf and Lethwaite's Optimizing Performance Through Intrinsic Motivation and Attention for Learning while being integrated with autonomy support (AS) and enhanced expectancies (EE) for promotion of motor learning and performance (SERTIC et al., 2021). As studies support propositions of the OPTIMAL theory by suggesting that motivational aspects of AS, EE, and EF have a role in assisting motor control and learning (SERTIC et al., 2021), AS and EE will also become important factors in teaching a handstand. Self-regulated practice will be discussed to aid the participants autonomy through being given ownership over some parts of the practice such as how much they practice, when augmented feedback is given, or how to organize the practice schedule (Schmidt & Lee, 2020). Utilizing video feedback that shows progress from session to session can enhance expectancies for the next practice session if the feedback that is given is positive (Schmidt & Lee, 2020). However, as images impact the brain through motor circuits by responding to the environment, the participant can have an adverse behavioral response if only shown negative images of poor handstand attempts (Coombes et al., 2005). As this participant has been frustrated with the lack of progress in the past year of attempting handstands, video feedback should be sensitive in producing positive feedback to create motivation for the duration of the motor skill learning process (Potdevin et al., 2018).

There is also importance in differentiating learning that is based on steady practice in practicing skills regularly versus performance that is based on a single observation (Schmidt & Lee, 2020). While learning, relatively permanent improvements are made in the ability to perform through practicing skills; however, practice can vary in having a permanent or temporary impact on performance levels (Schmidt & Lee, 2020). The goal would be in finding practice conditions that develop the relatively permanent changes necessary for repeated success of a handstand hold, and deliberate practice is one way to ensure practice time is optimized (Schmidt & Lee, 2020). Deliberate practice is described as specific activities produced with effort aiming towards a goal of improving performance (Davids & Baker, 2007) and the extent one can perform optimally is mirrored in the measurement of abilities required to perform the handstand matched with the skills attained through deliberate practice (Schmidt & Lee, 2020). Delayed retention and transfer tests may evaluate the true level of skills learned during practice as when returning 24 hours after practice the temporary effects wane and the participant would then be able to test the handstand skill to reflect learning (Schmidt & Lee, 2020). If the results on a transfer test show improvements in the handstand hold based on body sway, then the relatively permanent capability for performance in this skill would be shown and the participant would have learned (Schmidt & Lee, 2020).

Teaching a skill involves many processes that integrate for optimal learning such as defining and classifying a skill, identifying processing stages and memory systems, optimizing proprioception for comprehension of body movements, the importance of visual fields and an external focus of attention, applying the OPTIMAL theory when appropriate, motivational factors of positive feedback and images, and in determining if learning was attained during practice. As research is constantly evolving in interventions to optimize motor performance and learning, a professional should be knowledgeable regarding leading ways to implement motor skill programs.

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