GOLF SKILL: THE EFFECTIVE ACQUISITION AND APPLICATION OF BIOMECHANICS

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Contemporary applied golf practice is littered with instructional advice and products purported to improve the biomechanics, and ultimately performance of the golf swing. In this presentation I will apply skill learning theory to assess the relative efficacy of the common approaches claimed to facilitate golf skill as they relate to instruction, feedback and guidance devices.

KEY WORDS: skill, expertise, instruction, feedback, guidance.

INTRODUCTION: It would be difficult to find another sport with as many coaching texts as there are for golf. In general terms these texts all contain a similar structure in that the author/s claim to understand the most significant biomechanical aspects of the swing and in turn through a series of instructional cues and practice drills shape the swing of the reader (golfer/student). What is particularly interesting from a skill acquisition perspective is that much of the information presented requires the reader to cognitively invest in understanding the dynamics of the swing. Coupled with the technological evolution of biomechanical measurement capacity, golfers and practitioners have never been so informed on the neuromuscular nuances of the golf swing. This creates somewhat of a paradox from a skill learning perspective. While it has been consistently demonstrated that skilled performers find it difficult to accurately self-report on the automatic processes used to control their skills (Abernethy, 1994), the methods used to coach golfer's (both through instruction and feedback) seems in many instances to be focused on explicit instruction about these very processes.

INSTRUCTION: A large volume of work has considered the above paradox from the perspective of how instruction can influence how a learner processes and retains the dynamics of a skill. Two somewhat related instructional dichotomies have been most prevalent in enhancing our understanding of the influence of instruction on skill acquisition over last 15 years.
Implicit and explicit instruction: As highlighted in the introduction the ultimate intention of skill acquisition is for a performer to develop automated movement control. Ironically to achieve this aim, many coaches provide their performer's with "explicit" knowledge of the skill through rules and instructions, of which learners are consciously aware (Masters, 1992). It is argued that these explicit rules can be provided to learners in a time-efficient manner to facilitate rapid improvements in skill acquisition. In contrast, "implicit" motor learning is based on the premise that positive learning outcomes can be achieved by minimising provision of explicit information early in the learning process (Masters, 1992). In other words, implicit motor learning is based on the performer not needing to acquire conscious mechanical rules for control of the practised skill. The purported benefit of this type of learning is that it minimises the likelihood that performers will consciously focus on the mechanical rules when under performance pressure and in turn minimise the occurrence of the colloquially termed "paralysis-by-analysis" (see Masters, 2008 for an applied review).
Internal and external focus of attention: An alternative instructional method is to consider what does the provision of instruction do to a learner's focus of attention. Again a dichotomy has been used to examine this issue. Internally focused instructions direct a learner's attention to their body movements (e.g., "focus on your wrist cock") whereas an external focus of attention directs attention to the movement effect, or outcome, one is attempting to achieve ("focus on the ball's trajectory") (see Wulf, 2007 for a review). In general terms it has been demonstrated in a wide variety of tasks and contexts, including golf, that an external focus of attention promotes greater movement effectiveness (e.g., Wulf & Su, 2007).

In both instances, it is clear that the accrual of instructional tips based on the biomechanics of the golf swing may be at odds with contemporary skill acquisition theory as they may create players with an overly explicit knowledge-base or an internal focus of attention, both of which may be detrimental to ultimate skill learning and performance.

FEEDBACK: Development and innovation in biomechanical feedback devices has been significant. Most notable has been progression in the ease of use, allowing coaches to "do it themself" and not require the expertise of a biomechanist. This accessibility combined with enhanced measurement precision and "real time" feedback capabilities to "accelerate" skill learning has created a raft of opportunities for the provision feedback. Unfortunately, despite the obvious potential, evidence-based use of such tools is sparse (see Abernethy, Masters & Zachry, 2008; Bartlett, 1997). Not only has there been limited empirical work completed with many of the new feedback devices available, but the extant feedback literature has been predominantly developed in laboratory-based research programs with an emphasis on the skill learning of novices completing simplified movement tasks (see Abernethy et al., 2008). Two established feedback concepts will be considered where current application seems at odds with existing theory.

Feedback precision: A critical question for any practitioner is what level of feedback precision should they provide to the learner. In practice, it is seemingly often presumed that more (precision) is better. For example, reports generated from 3D analyses are provided to golfers that detail to the degree differences from swing to swing, or between themselves and an expert model. While the precise biomechanical capture of a performer's current swing is of value, whether the performer has the capacity to differentiate 2 degrees from 10 degrees and change their swing accordingly is a matter of debate. As highlighted by Abernethy et al. (2008) more precise information may be related to levels of skill control that are below the consciousness of a performer and hence difficult for them to actively control during the skill learning process.

Video feedback: A common use of video feedback is to overlay, split-screen or frame by frame analyse a learner's swing with that of an expert model. Again empirical evidence to support such practices are sparse and equivocal (Guadagnoli, Holcomb & Davis, 2002). A particularly interesting finding concerns what information learners pick up from a demonstration. Evidence suggests it's the invariant relationship between two components of the skill (i.e., coordination) rather than any one particular characteristic (e.g., club head speed) that is acquired (Scully & Newell, 1985). This has important considerations for video feedback where high-speed frame by frame analysis or simply still images of performance are replayed. In such cases, it is arguable whether the relative motion of the skill (i.e., coordination) is being displayed and hence whether there is any learning value.

Guidance: As discussed, while golf is famous for the volume of coaching manuals on book shelves, it is equally famous for the number of guidance devices available that purportedly "fast-track" the development of one's swing. Guidance devices actively constrain a performer's movement pattern such that it conforms to a pre-determined and accepted skill technique. It is subsequently claimed that such approaches lead to fast-tracked learning of the skill. Such claims are particularly attractive for novices still assembling a basic pattern of coordination for a complex skill like the golf swing. However, despite the intuitive logic of such devices there is typically little empirical evidence to support their use. While such tools can be useful for developing a 'ball park' approximation of a golf swing (see Button, Cundaris & Lamb, 2010) and reduce the need for verbal explicit instruction from a coach, the long term legacy of such practice is debatable. A key issue is that the learner becomes passive in the learning process in turn limiting their ability to interpret their own response-produced intrinsic feedback (i.e. proprioceptive feel). A worst case scenario is the guidance device is over-used and that the learner becomes dependent on practicing with the device (see Schmidt, 1991). Consequently, the processing requirements for control of the skill are altered and this diminishes the likelihood of any transfer of learning.

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