Professionalism, Golf Coaching and a Master of Science Degree:

A Commentary

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INTRODUCTION

The stimulus article represents another in a series of well-researched and carefully-compiled pieces on the science and philosophy of golf coaching by Simon Jenkins. Dr. Jenkins has done a fine job at assimilating information from a diverse range of sources to support and justify the creation of a new Master of Science degree in golf teaching/coaching, which he suggests could facilitate the development of professionalism among golf coaches.

In principle, I support the development of this postgraduate programme, which has the potential to increase awareness and understanding of the role that science and technology plays in enhancing golf performance. Although the marketplace is currently saturated with 'professional' certifications provided by predominantly commercial enterprises (e.g., Titleist Performance Institute, Nike Golf 360, Golf Biodynamics, The Golfing Machine, Trackman University, etc.), a formal qualification earned through a reputable academic institution with a strong sporting pedigree, which involves a sustained period of study and the opportunity to undertake original applied research, should be attractive to, and welcomed by, the more aspirational and analytically-minded golf coach.

Given the stiff competition, this postgraduate qualification needs to quickly gain credibility and acceptance among golf coaches and, ideally, their representative body, the Professional Golfers' Association. To increase the esteem in which the course is held, I believe the sport science component needs to be based on cutting-edge theoretical and empirical research that has preferably been subjected to the rigours of peer-review. I am empathetic to Dr. Jenkins' apparent desire to adopt a theory-driven approach that considers the golfer from a more holistic perspective, so in the remainder of this commentary, I will outline a theoretical model that could provide a platform on which to integrate the various subdisciplines of sport science to gain a more complete understanding of golf performance.

THE NEED FOR A UNIFYING THEORETICAL MODEL OF THE GOLFER

It is generally accepted that proficient golf performance is dependent on a multitude of factors, including physiological fitness, physical development, psychological preparedness and biomechanical efficiency. Most performance-related scientific research in golf, however, has tended to be monodisciplinary in nature with most studies being conducted within the confines of one of the subdisciplines of sport science. Few studies have attempted to integrate principles, concepts and data from, for example, biomechanics, physiology or psychology despite calls by Farrally et al. [1] and others to do so.

One of the reasons why interdisciplinary research into golf performance has been scarce might be that a unifying theoretical model of the golfer, capable of integrating the subdisciplines of sport science, has yet to be established. A model that could fill this void—and potentially provide the theoretical basis for the proposed Master of Science degree in golf teaching/coaching—has been described by Newell [2]. An adapted and extended version of his constraints-based framework as applied to golf is provided in Figure 1. This tripartite model has been the cornerstone of many dynamical systems investigations of human movement and it has been applied to a variety of areas, including: talent identification and development [3]; sport medicine [4] and physical therapy [5]; skill acquisition [6]; strength and conditioning [7,8]; sport biomechanics [9-11]; and sport performance analysis [12,13].

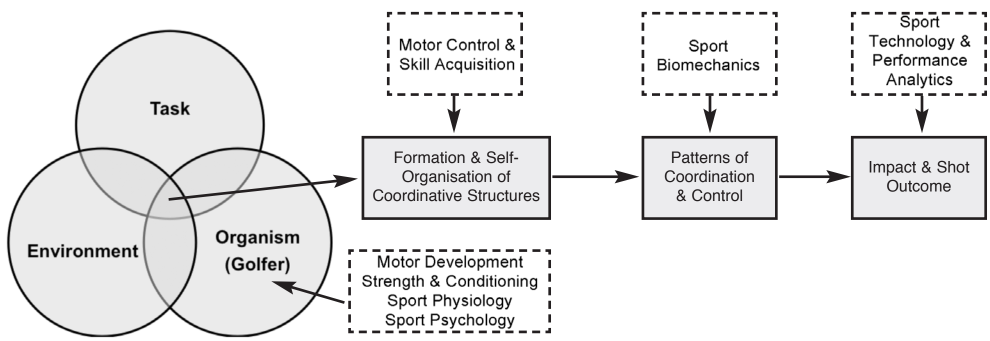

Figure 1. An Adapted and Extended Version of Newell's [2] Model of Constraints as Applied to Golf
The shaded areas summarise how patterns of coordination and control, which ultimately determine impact conditions and shot outcome (assuming constant environmental conditions), emerge from the confluence of interacting constraints via the formation and self-organisation of coordinative structures. The unshaded areas indicate where the various subdisciplines of sport and human movement science could be integrated into the model to provide interdisciplinary insights for a more comprehensive and holistic understanding of golf performance (see text for further elaboration).

A central tenet of this model is that the coordination and control of the golf swing, which directly determine impact conditions and shot outcome (assuming constant environmental conditions), emerge from the confluence of interacting constraints via the formation and self-organisation of task-specific structural units known as coordinative structures (see the classic papers by Turvey and colleagues [14-17] discussing the degrees of freedom problem and its solution).

According to Newell [2], constraints can be categorised as being either organism-, environment-, or task-related. Organismic constraints are those that are internal to the golfer, including height, body mass and composition, anthropometric and inertial characteristics of body segments, and muscle fibre composition. Environmental constraints are those that are external to the golfer, including ambient light and temperature, surface compliance and topography, and acoustic information. Finally, task constraints are those requirements that have to be met within some tolerance range in order to perform successfully. In golf, task constraints typically only have a spatial component, such as hitting to a particular region of the fairway or putting towards the hole. Rules governing the game, clubs used to perform it, and instructions issued by a coach can also be classified as task constraints. For further examples of the different types of constraints in golf, see Glazier and Davids [18].

Newell's [2] constraints-based model not only provides a more holistic understanding of golf performance than other, more traditional, computational (information processing) approaches adopted in previous studies of the golf swing [19,20], it also offers a viable platform on which to integrate the various subdisciplines of sport and human movement science to gain a more comprehensive understanding of golf performance. The potential roles and contributions of the different subdisciplines are summarised in the unshaded areas of Figure 1 and elaborated briefly below:

1. Performance analysis can interpret shot outcome data obtained from databases such as ShotLink® to objectively identify variables and playing strategies that are associated with proficient golfing performance [21,22].
2. Sport technology can provide the tools for measuring and analysing impact conditions and ball flight. Launch monitors such as TrackMan® provide extensive information about club (e.g., speed and path, attack and face angles, dynamic loft, etc.) and ball (e.g., speed, launch angle, spin rate, etc.) dynamics. The shot outcome is deterministically related to the initial launch conditions and governed by the 'ball flight laws' [23]. The data provided by these devices can be used as a basis for guided discovery learning in which augmented information is used to channel, rather than to specify, the movement patterns to be adopted [24]. Indeed, anecdotal reports from top golf coaches indicate that this method of instruction may be superior to more traditional position-focused teaching methods [25].
3. Sport biomechanics can provide the methods and tools for measuring and analysing patterns of coordination and control predominantly at the behavioural level of analysis [10,11]. The neuromuscular level of analysis is accessible, but measurement tools and techniques for measuring the output of individual degrees of freedom (e.g., muscles or motor units) are somewhat limited at present [26].
4. Skill acquisition and motor control can enhance understanding of how coordinative structures are formed and how their morphology changes during learning [27,28], how practice design and training environments can be manipulated to accelerate their assembly and optimisation [29], and how the degrees of freedom comprising them re-organise as internal and external constraints change.
5. Sport physiology and psychology can provide the methods and tools for measuring and analysing key functional organismic constraints, such as fatigue and anxiety, which have both been shown to have a substantial impact on the interaction and (re-) organisation of degrees of freedom at different levels of analysis [30-33].
6. Motor development can provide insights into how structural organismic constraints, such as strength and flexibility, change across the lifespan and how they shape and impact on golf performance. Movement variability and consistency have been identified as important issues [34], especially among the senior golfing population [1]. Research has shown that there is a change – typically a loss – of 'complexity' (i.e., flexibility/adaptability/variability) in biomechanical and physiological processes with age, although this change is largely dictated by the confluence of constraints on action [35,36].

7. Strength and conditioning can contribute to the development of structural and functional constraints through carefully devised and implemented training interventions [7,8]. The contribution of this subdiscipline is important during preparation for competition since any physical and physiological deficiencies or weaknesses in individual degrees of freedom may compromise the structural and functional integrity of its constituent coordinative structure, thereby potentially jeopardising its collective output. Functional movement screening may provide useful prescriptive information, although golf-specific tests, such as the Titleist Performance Institute movement screen [37], still require further, more robust, validation.

The above list is not intended to be exhaustive or definitive, but rather it should be viewed as a guide as to how the various subdisciplines of sport and human movement science can work more interactively—using the constraints-based model provided by Newell [2] as a theoretical backdrop—to gain a deeper, more complete, understanding of golf performance. This type of interdisciplinary integration, in my view, is the future of golf science and aspiring golf coaches would benefit from being made aware of the advantages and opportunities it affords.

CONCLUSION

The proposed Master of Science degree in golf teaching/coaching has the potential to increase awareness and understanding of the role that science and technology plays in enhancing golf performance. This initiative would benefit from adopting a theory-driven approach that considers the golfer from a more holistic perspective. The constraints-based model introduced by Newell [2], which has been elaborated on and applied specifically to the golfer in this commentary, offers a viable platform on which to integrate the various subdisciplines of sport science and gain a more comprehensive understanding of golf performance. Accordingly, I recommend that this model forms the theoretical foundation for this postgraduate programme.

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* An earlier version of this web-article was published on the now-defunct Coaches' Information Service website hosted by the International Society of Biomechanics in Sports. The full reference for that version was: Glazier, P. and Davids, K., Is There Such a Thing as a 'Perfect' Golf Swing?, *International Society of Biomechanics in Sports' Coaches Information Service, http://www.coachesinfo.com/*, 2005.

EDITOR'S NOTE

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