Considerations for Application of Skill Acquisition in Sport: An Example from Tennis

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Abstract

Skill acquisition principles are crucial to prepare athletes for superior performance in sport, but, in training athletes, coaches have focused less on these principles than they have on the design of training. This paper provides an overview of how a skill acquisition specialist disseminated scientific knowledge to amateur and professional coaches and initiated collaboration to improve practice design. First, a framework of representative task design is outlined, which considers perception and action components of sports skills in practice tasks relative to the competition setting. Second, with elite tennis as an example, steps are described as to how the skill acquisition specialist can initiate collaboration with coaches to evaluate practice tasks and make recommendations using representative task design. This approach includes delivery of a seminar to educate coaches, observation of practice tasks to rate representative task design with recommendations made, and factors identified by coaches that should be considered when applying skill acquisition principles. Factors identified by coaches related to presentation of anticipatory cues, practice variability, individualization of practice, skill complexity, and consistency of skill tests. Collectively, this paper provides insight into how skill acquisition specialists can collaborate with coaches to disseminate knowledge, and it presents some of the challenges and solutions of designing representative practice tasks in sport.

Keywords

Skill acquisition specialist, coach, representative task design, anticipatory cues, variability of practice

Introduction

Perceptual-cognitive-motor skills have been identified by elite coaches and professional athletes as crucial discriminators of expert performance in sport (Fullagar et al., 2019; Steel et al., 2014). In addition, several books have been published to disseminate broadly the knowledge of key perceptual-cognitive-motor skills, such as anticipation, and to explain that consistently training these skills is vital for superior performance in sport (e.g., Ericsson et al., 2018; Williams & Jackson, 2019a; Zaichkowsky & Peterson, 2018). Despite this resounding call for a greater emphasis on perceptual-cognitive-motor skills, there remain significantly fewer skill acquisition specialists than there are other sports scientists collaborating with coaches to develop athletes (Dehghansai et al., 2019). This less frequent collaboration could be due to lack of appropriate coach education resources and/or initiative taken by skill acquisition specialists to collaborate with coaches. Therefore, the purpose of this paper is to provide a brief overview of the following: (a) how skill acquisition specialists can improve education of practitioners in terms of key principles related to expert performance and learning in sport, and (b) factors that should be taken into consideration when working with the coach to implement skill learning principles when designing practice tasks.

Representative Task Design as a Framework to Design Practice Tasks

Representative task design (Araújo & Davids, 2015) is a popular skill acquisition framework that can provide guidelines for coaches to apply key principles of skill learning. This framework can be employed by the skill acquisition specialist or coach to evaluate, and refine, the design of practice tasks (Pinder et al., 2011). Representative task design in the context of sports skills is defined as perception and action components that are structured in practice in order to target similar components that exist in competition (Krause et al., 2018). The purpose of such design is to guide the establishment of practice tasks that can facilitate positive transfer of skill learning from training to competition environments (Rosalie & Müller, 2012).

The perception component of representative task design refers to visual information that can be used by a performer in order to guide or inhibit an action (Araújo & Davids, 2015). In tennis, for example, this can include visual cues from the opponent's movement pattern used to anticipate serve direction. The action (or motor) component of representative task design refers to the performer's response relative to available perceptual information (Araújo & Davids, 2015). In tennis, this can include the beginning of a practice drill with a serve followed by subsequent action responses involving a return of serve, groundstrokes, and/or a volley. Coaches can design practice tasks by taking into consideration the components of representative task design and then incorporating additional skill acquisition principles to facilitate learning and transfer of skill. Accordingly, two key principles that should be considered in relation to representative task design include pick-up of cues for anticipation (Shim et al., 2005) and variability of practice (Hodges et al., 2014).

In high-speed striking sports, pick-up of visual cues for anticipation is a key principle of expert performance, which has been well established in the literature (Morris-Binelli & Müller, 2017; Williams & Jackson, 2019b). Visual cues can be gleaned from situational information such as opponent position on the court (Loffing & Hagemann, 2014) and serve preferences relative to game score (Farrow & Reid, 2012) in order to anticipate serve type in tennis. Visual cues can also be gleaned from opponent kinematics such as the racquet plus playing side arm (Jackson & Mogan, 2007) and lower body (Abernethy & Zawi, 2007) to anticipate serve or stroke direction in tennis and badminton, respectively. Situational and kinematic information can be used to guide positioning of a performers body, with object flight information used to guide interception (Müller & Abernethy, 2012). A growing body of evidence has reported that in skilled and emerging expert athletes, pick-up of visual cues can be improved using video-based temporal occlusion training, with transfer to field settings (Alder et al., 2016; Müller et al., 2017). Therefore, it is important for coaches to ensure that presentation of anticipatory cues is a key component of representative task design when designing practice tasks.

Organization of practice both within- and between-skill type execution is also important in the action component of representative task design (Krause et al., 2018). Within-skill execution refers to constant and variable practice (Porter & Magill, 2010). In tennis, constant practice could include repeated execution of a slice backhand to one location on the court, while variable practice would encourage repeated execution of a slice backhand to different locations on the court. Between-skill execution refers to blocked and random practice (Porter & Magill, 2010). Again, in tennis, blocked practice includes practice of serve, forehand, and volleys sequentially, while random practice includes practice combinations of these three skill types. Literature indicates that blocked practice shows immediate performance benefit; however, variable practice facilitates superior learning and transfer to field settings (Cheong et al., 2016; Williams et al., 2018). Accordingly, when designing tasks for learning, coaches need to consider that representative organization of practice is important to facilitate transfer. Therefore, coaches should be made aware of the components of representative task design. This coach education process is discussed in the next section.

How Can Skill Acquisition Specialists Collaborate with Coaches to Evaluate and Guide Design of Practice Tasks?

It has been reported that coaches prefer to learn about the application of sports science evidence through one-on-one and small-group conversations or seminars (Fullagar et al., 2019). Accordingly, our research group ran a half-day researcher-practitioner seminar to enable attendance of coaching staff who had time limitations. In 2019, 24 amateur and professional coaches from a variety of sports in the local area attended the seminar held at Murdoch University, Perth Campus. In 2020, 72 amateur and professional coaches from approximately 10 different sports in the local area attended the seminar held at the Western Australian Cricket Association (WACA) Ground.

At each seminar, the following content was presented: First, a researcher introduced the seminar theme of psycho-perceptual-motor skill (sport psychology and skill acquisition), which was underpinned by the framework of representative task design; second, a series of task design presentations was delivered including keynotes from national coaches in relation to the importance of psycho-perceptual-motor skill for athlete development. Researchers then presented on topics such as anticipation and variability of practice, with examples of how to assess and train athletes. Finally, graduate students and researchers provided practical demonstrations of tools used to assess and train anticipation. In addition, the research group wrote a brief set of guidelines on the application of psycho-perceptual-motor skill knowledge targeted at practitioners in a variety of sports (Müller et al., 2019). The purpose of these guidelines was to be used as a follow-up conversation starter beyond the seminar.

In relation to the 2019 seminar, feedback from coaches across a variety of sports such as cricket, Australian football, field hockey, and tennis, indicated that the seminar was well received with principles that had direct application to athlete development (Murdoch University, 2019). An online questionnaire (including a 5 point Likert scale: 1 strongly disagree to 5 strongly agree) conducted after the 2020 seminar including 26 respondents indicated the following: The seminar was professionally organized (M = 4.66), content was thought provoking (M = 4.31), and topics presented were relevant to development of athletes and coaches (M = 4.42). 92.31% of respondents indicated they wanted the seminar to continue annually. This feedback presented an opportunity for a skill acquisition specialist to approach a group of high-performance tennis coaches to converse regarding application of skill learning principles for athlete development. From this conversation, collaboration was explored that consisted of a formal applied research project or assessment of representative task design with recommendations for design of practice tasks. The latter opportunity was chosen due to the limited collaboration between skill acquisition specialists and coaches for implementing skill learning principles (Dehghansai et al., 2019).

Upon invitation by the head coach of a Tennis Australia state academy consisting of junior emerging expert athletes of 11-17 years old, the skill acquisition specialist attended one squad practice session per week over a four-week period. This academy program in the calendar year consisted of three to four sessions per week for a twelve-week period. A series of practice drills was observed live and rated using a previously validated tennis-specific representative task design scale (see Krause et al., 2018). The scale was used to rate the drills with some achieving higher and lower overall score in representative task design. Briefly, several of the drills commenced with an underhand feed of the ball and some included reduced variability of skill type practice. It is important to highlight here that these observations were reflective of the selected point in the observation period of the program. Thereafter, the skill acquisition specialist presented the ratings in summary documents and discussed them in a face-to-face meeting with coaches. This meeting identified several important factors that should be considered by the skill acquisition specialist and coach to modify drills in line with representative task design. In the next section, these considerations are discussed along with solutions to guide future collaboration between skill acquisition specialists and coaches.

Considerations for Implementation of Representative Task Design in Junior Emerging Expert Tennis Players

Skill complexity. Coaches mentioned that junior athletes have differing levels of capability in the consistent execution of complex skills such as the serve into specific locations of the service court. This can limit design of a drill where representative serve-anticipatory cues are presented. Furthermore, concern was raised by coaches about using a serve to start a drill, as this can take more time due to “faults,” thus increasing overall time taken for all practice tasks planned in a session. Several solutions could be considered and applied as follows: First, athletes of comparable skill levels could be paired during squad practice so that the serve can be used as the feed to begin a drill. Second, those athletes who can serve could be specifically utilized in some drills. Both these solutions are aligned with another skill acquisition framework that states practice task challenges should be individualized (Guadagnoll & Lee, 2004). Third, less capable servers could be required to use a second serve of slower velocity to increase accuracy into the service court. This solution is supported by recent evidence that indicates tennis players can differentially prioritize speed and accuracy when performing strokes (Krause et al., 2019). These solutions will ensure that the important anticipatory cues are included as part of representative tasks in tennis.

Blocked to variable progression of practice tasks. Coaching staff mentioned that athletes may begin the program not having participated in tennis practice due to school holidays. Accordingly, a progressive design from blocked/constant practice towards more variable practice was deemed necessary to provide appropriate transition for the athlete. This is a reasonable justification, but, as a solution, every second squad session could include increased practice variability, such as blocked/variable or random/variable schedules. This would ensure that athletes are exposed to variable practice, which has been reported to facilitate superior learning and transfer when compared to constant/blocked practice in field-settings of junior tennis players (Broadbent et al., 2015). In addition, increased practice variability will ensure that an implicit mode of learning is prioritized (Rendell et al., 2011). Implicit learning is defined as improvement in motor skill performance without knowledge that can be verbalized (Masters, 1992). Increased practice variability can create an implicit mode of learning because of interference between tasks that may limit verbal knowledge accumulation (Rendell et al., 2011). Implicit learning has several benefits over explicit learning such as less attention required for the primary motor skill allowing multi-tasking that can ensure robustness under psychological and physiological stress, as well as retention for a longer period of time (Masters, 2013). These characteristics of implicitly learned skills are highly beneficial for transfer to the high-pressure competition setting. Second, athletes can be given autonomy support to select increased or decreased variable practice sessions; this has been reported to facilitate superior skill learning (Wulf & Lewthwaite, 2016). Therefore, more frequent incorporation of variable (representative) practice along with autonomy to select practice organization will ensure squad sessions maximize skill learning and transfer.

Consistency of motor skill execution. Coaches mentioned the need for athletes to consistently practice tennis stroke movement patterns and achieve target location of stroke outcome. To this, a high degree of constant repetition was deemed necessary to develop these components of skill. As mentioned earlier, it should be considered that variable practice facilitates superior learning and transfer over constant/blocked practice (Cheong et al., 2016). Accordingly, excessive constant practice of skill types is less likely to develop adaptable movement patterns to achieve accurate skill goals (Davids et al., 2013). The coach, however, should also be aware that practice variability will increase the cognitive load experienced by the athlete, and practice performance in a session may be "messy" (Rendell et al., 2011). Therefore, every practice session does not require high practice variability, thus guarding against lowering of athlete motivation and self-efficacy that are also necessary for skill learning (Lewthwaite & Wulf, 2017).

Individualized practice tasks. Coaches mentioned that junior athletes were at different stages of skill development. Hence, an individualized approach to design of practice difficulty was considered essential. This is indeed the premise of the individualized practice challenge framework mentioned earlier (Guadagnoll & Lee, 2004). To this, more recently, researchers investigating anticipation training and practice variability have begun to focus more on individual differences. For example, Müller et al. (2017) reported that some individual field hockey goalkeepers improved their capability to save drag-flicks on goal after anticipation training. Other goalkeepers may have needed a longer duration of anticipation training to transfer benefits to the field-setting. In another example, Pacheco and Newell (2018) reported that practice in throwing an object at a target involves highly individualized coordination patterns that can be transferred to different settings. Therefore, it is important to design practice tasks and skill tests at the individual athlete level.

Consistency of conditions in skill tests. Coaching staff questioned whether it is possible to design a tennis-specific on-court skill test to assess and re-assess athlete performance improvement due to implementation of skill learning principles. The main concern was that consistent individual, task, and environment conditions should be maintained across assessment time points in order for comparisons to be made. It should be taken into consideration that field-based tests can be controlled only to a certain degree. For example, in field-based anticipation tests, a tennis return-of-server has been required to wear occlusion glasses to control visibility of the server's movement pattern and ball flight until it reaches the net (Farrow & Abernethy, 2003). The return-of-server is required to anticipate direction of serve and attempt to return. Typically, two skilled opponents (e.g., servers) are used in these field-tests so that enough trials can be presented to the returner without causing overt fatigue or injury to the opponent. However, server kinematics and ball flight trajectory will never be the same from trial-to-trial. Field-based tests designed by skill acquisition specialists in consultation with coaches have controlled conditions to a degree such as; consistent presentation of opponents, object velocity, and skill types. These tests have been able to discriminate superior performance in highly dynamic sports skills such as goalkeeping in ice hockey and small-sided games in Australian football (e.g., Panchuk & Vickers, 2006; Piggott et al., 2018). Therefore, a balance is required in terms of control of "messy" conditions that are representative of competition (Davids et al., 2013).

Summary

This paper set out to provide a brief overview of how the skill acquisition specialist could better educate and work with coaches to optimize practice task design. Based upon coach feedback sourced from a questionnaire, a half-day researcher-practitioner seminar that presented topical issues in relation to psycho-perceptual-motor skill was an effective way to disseminate knowledge. Coaches also liked written guidelines that were e-mailed after the seminar to allow reflection upon content presented and their practice design. Thereafter, observation and rating of representative task design, with recommendations to modify practice tasks, followed by an interactive discussion, raised several important factors that should be considered. It is hoped that the solutions to considerations raised by coaches presented here may allow coaches and skill acquisition specialists to collaborate better in future. To this, the state tennis academy coaches mentioned stimulation of their thinking further of how their practice tasks are aligned with skill acquisition principles. In addition, the head coach of the state tennis academy immediately began to incorporate shot selection decisions into practice drills to increase representative task design. In future, questionnaires for coaches, together with qualitative analysis of coaches' thoughts and practices, as well as follow-up observation of athlete practice tasks could be conducted to determine more systematically whether presented skill acquisition advice was implemented by coaches. Nonetheless, as presented in this paper, it appears that in a very short timeframe a positive collaboration was achieved between the skill acquisition specialist and elite tennis coaches. Similar collaborations are anticipated in several other sports.

Author's Declarations

The authors declare that there are no personal or financial conflicts of interest regarding the research in this article.

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