

## 18

REFINING MOTOR SKILLS  
IN GOLF

## A biopsychosocial perspective

*Howie J. Carson and Dave Collins***Introduction**

For all golfers, especially those committed to a performance pathway, progression is not constant across involvement (MacNamara et al., 2010b). Undoubtedly, novices become more skilled with practice, largely through improvements in technical proficiency and consistency (Gentile, 1972). Indeed, skill acquisition theory explains this relative permanence of skill as resulting from increased automaticity (Fitts & Posner, 1967), a hallmark of learnt skills as execution processes become committed to subconscious control (Beilock et al., 2004). Notably, however, long-term performance gains are sometimes more difficult to achieve as practice volume increases, irrespective of skill level – often termed a ‘performance plateau’.

In fact, once skills are automatized, implementing refinements, or tweaks, presents not only the more significant but also more common challenge for golfers. Thus, players may wish to make changes across a broad front, for instance, to improve proficiency, in response to new equipment regulations (e.g., shallower grooves), course demands (e.g., lengthened holes), improved competitors, ageing, or prevent/return from injury. Indeed, fixing ineffective but well-automatized movements constitutes a significant part of some coaches’ everyday role (as opposed to teaching the acquisition of new skills). Furthermore, if golfers are willing to commit to making these modifications, it would seem desirable that they be long-lasting and robust under highly pressurized conditions.

Considering the importance of successful refinement to skills that are already learnt, long-practised, and well established, these challenges have, however, received surprisingly scant research attention (e.g., Schack & Bar-Eli, 2007). Accordingly, this chapter is targeted at assisting coaches working with experienced players, whether seasoned 15-handicappers or Tour professionals. Specifically, it aims to review and critique three key dimensions to achieving successful skill refinement. Firstly, the need for an interdisciplinary perspective towards player development; secondly, the role of planning and the nature of the coach’s decision-making processes; and thirdly, the training programme required. In the following sections, implications and future research directions are offered for applied coaching practice in skill refinement.

**Review of current research***The importance of an interdisciplinary perspective*

As science support has become a common feature across sports, recognition has emerged for the ways in which disciplines may collaborate and integrate with the job of the coach. However, despite important and well-argued papers making this point some time ago (e.g., Burwitz et al., 1994), uni- and multidisciplinary models still predominate. In short, truly interdisciplinary approaches, where specialists work in an integrated fashion, with strong, effective communication and towards commonly agreed objectives, are still the exception. If golfers, coaches, support practitioners, and managers would rather consult nutritionists about food, fitness consultants about training, and psychologists about mental challenges, they fail to notice that elements of all three and their interactions will typically underpin performance issues. Using this silo approach neglects the increasingly accepted fact that almost all human issues are both complex and biopsychosocial in nature. Indeed, interactions between these different elements often play an even greater part in determining behavior and outcomes than the distinct factors themselves.

An example may add clarity. A golfer may report problems with maintaining attentional focus, which, after careful evaluation, can be largely attributed to an overuse of simple carbohydrates at breakfast and poor hydration on course. Dietary changes are made, with the player announcing to her/his friends and family that she/he has decided to really work holistically on her/his game. In such a case (and not exclusive to golf; cf. Collins et al., 1993), performance may well improve resulting from changes in biochemistry (the Bio), expectancy effects, better body image in the golfer (the Psycho), and increased support, plus expectancy impacts from her/his peers (the Social). A well-informed support group will work with the golfer and coach to optimize the impact of a change, exploiting all three elements and the interactions to maximize performance effects. Importantly, the particular blend of bio, psycho, and social will vary depending on many factors, for example, across golfers, the state of the change (e.g., early or later in the intervention), and the influence of those practitioners suggesting/driving the change.

The origin of knowledge is another important consideration. Regarding the science underpinning the change (which may itself be multifaceted), consumers need to be aware of the originators’ intentions. As shown by Collins and Kamin (2012), scientists can be motivated by work through, of, or for sport. Therefore, research will look to examine rather fundamental effects through the use of golf situations. For example, consider much of the work on implicit learning (e.g., Maxwell et al., 2000), where novices learn a very simple putting task (e.g., flat 10 ft. putt). In such cases, the authors’ motivation is to increase their knowledge of implicit learning through use of a golf-like task. It would, therefore, be questionable to uncritically transfer and apply these results to work with Tour professionals. By contrast, the Five-A Model (Carson & Collins, 2011), which is addressed later, was developed for application using what is known as a pragmatic approach (cf. Giacobbi Jr. et al., 2005). Add to these sources the bewildering array of gurus and experts available through social media (MacNamara & Collins, 2015) and the challenge becomes even greater. Sound advice is to always be aware of the source and intention of the advice, applying a dose of healthy critique, or even scepticism, to ideas before they are tried and tested with performers.

These concerns notwithstanding, it is an important realization that coaching for technical refinement should be fundamentally biopsychosocial in nature and exist within an ongoing player-coach relationship. Accordingly, the skilled coach should be aware of the contribution of each of the three elements, as well as their interactions, towards player performance and

progress. Coaching is certainly not one-dimensional or unidisciplinary, even if so many of the coaching and performance aids currently on the market are!

So, what might a truly biopsychosocial approach look like? Imagine that coach and player have decided to implement technical change. The predominant focus of the coach is, traditionally at least, on the bio – the technical change itself. Building on previous points, a comprehensive treatment will also address the other two elements. The coach will address the psycho by ensuring the golfer's confidence in the change, by maintaining confidence in progress, and by generating a positive view of the outcome to ensure motivation. From a social perspective, the coach will work to gain support for change from the golfer's immediate group. Avoiding dissenting voices as the change is made is essential. These ideas are now extended into the early stages of technical refinement, a time when the psychosocial dimensions are particularly important.

### *Planning and decision-making*

The need for a comprehensive biopsychosocial approach is particularly apparent in the early stages of refinement. Without careful and considered analysis, plus a strong selling job, there is a significant risk that the wrong decisions will be taken or, just as damaging, good decisions not followed through. Accordingly, coach and player will first need to ensure due diligence when considering making a change, weighing up the pros and cons of refinement against other options (cf. Toner et al., 2012). Crucially, one must ask if the change is worth it. Subsequent sections will testify that technical tweaks take time, especially when the skill must be reautomatized to ensure pressure-proofing. Accordingly, many considerations come into play, such as the player's age and when s/he needs to peak next; that is, how long until peak performance is next required. This is hard enough working with Olympic sports, for example, tweaking a judo player's throw can take 6 months. For golfers, where a 6-month absence from, or underperformance on, the Tour may necessitate requalification, the decision is even more complex.

Once these difficulties are addressed, it is then possible to get into even more devilish detail. How will the refinement take place? Can some waymarks be set so that progress can be monitored and demonstrated to all concerned? Will any specialists be brought in to help and, if so, does the need to get individuals completely trusted by the player add additional time to the planned schedule? Hopefully, this brief tour through the challenges of change is sufficient to evidence how carefully such decisions need to be made. Ultimately, coaches' and players' accounts show that changes are all too often initiated without sufficient thought (Carson et al., 2013). Indeed, coaches may often keep fiddling with skills inappropriately through a desire to contribute when the situation is a perfect environment for 'less is more'! Elements of role clarity, presentational bias, and authority often play a part in this tendency (Mallett & Pyke, 2008), which the wise coach will resist. Thus, in the present context, coaches must generate positive psychosocial support for change, a commitment and desire in the player, in parallel to the more usual bio (in this case, technical and mechanical) focus.

It is hoped that the need for a clear underpinning process is emerging. With elements of macro (overarching) and meta (thinking about) cognition, coaches in every sport, and certainly one as technically focussed as golf, can benefit from the development and application of more structured higher-order thinking. Thus, in the example above, the coach will use macrocognitive approaches to drive a process of decision-making, design, and implementation of technical change. Additionally, s/he will use metacognitive techniques to reflect on the process, making adjustments appropriately but not so regularly that the player is disrupted in making the change.

Interested readers should refer to an examination of these processes in adventure sports (e.g., Collins & Collins, 2015), which clearly demonstrates transfer at both macro and meta levels.

As these and other papers demonstrate, macro and metacognitive approaches are best considered under the umbrella approach of professional judgment and decision-making (PJDM). At its simplest, PJDM stresses the importance for a coach to consider the 'why' as much as, or even more than, the 'what' and 'how' of coaching. Inevitably, therefore, alternatives are always framed and critically considered, generating a more expertise-based approach to coaching. Indeed, this approach is viewed as taking coaching beyond the overly structured and reproductive system of competencies, which currently predominates in many coach accreditation programmes (Collins et al., 2015a).

In this regard, it is worth stating that such levels of macro and metacognition are characteristics of professions (cf. Winter & Collins, 2016). As Carr (1999) explains, when distinguishing teaching as a profession, the existence of a distinct knowledge base and clear autonomy of practice are key characteristics. Similarly, optimum golf coaching should be built on a specific and highly individual blend of techniques, drawn from a large library of knowledge on the basis of careful and ongoing reflection and weighing up of options.

Therefore, reflecting these twin ideas of biopsychosocial and PJDM, the next section presents a systemic structure within which the fine-tuning can take place. As another comparison, this structure provides the basic recipe against which the creative chef/coach can develop a refined and bespoke solution to meet the specific needs of each particular player. To push the principles of meta and macrocognition, a five-part process is suggested, which can be used at major decision-making stages. Accordingly, the truly reflective coach will follow this checklist:

- 'I have decided to . . .'
- 'Because . . .'
- 'But I considered these options . . .'
- 'And would have taken this alternative if the circumstances were changed to . . .'
- 'I will check my decision in X months and, if I was right, would expect to see . . .'

Consequently, alternatives are always considered and evaluated, countering the tendency to go with recipe approaches that have reportedly worked for others. There is a real tendency to equate the quality of performer outcome with the quality of coach input ('she's a great performer, so he must be a great coach'! cf. Nash et al., 2012) and golf is equally susceptible to this bias. The best counter is to always critically consider alternatives, to check with peers on the whys and wherefores of how they are coaching, and to regularly review progress against predicted benchmarks. Bear these factors in mind during the review of the structure and design of refinement-focussed interventions in the next section.

### *Training programme*

A third review addresses the mechanistic underpinnings necessary to generate long-term permanent and pressure-resistant refinement, thereby providing the important declarative knowledge of 'what needs to be done' and 'why', as well as the procedural knowledge of 'how to do it'. Unfortunately, many golfers struggle to bring about such change for a variety of reasons. Despite this inherent difficulty, however, coaching interventions must be able to cater to such possibilities and exploit these mechanisms on an individual basis as part of the approach, if they are to provide a first-class service to their clients. Of course, not all elements of training will be different for each golfer. On the contrary, common practices (or at least similar practices with



common aims) will be apparent, acting as primary facilitators of the change process as a function of human nature (refer also Prochaska & Prochaska, 1999). Understanding these basic principles should, therefore, be the starting point for further coach development in this area.

Addressing one crucial facilitator, and forming the focus of critique offered here, is the type of motor control required for long-term permanent and pressure-resistant outcomes. As identified earlier, the development of automaticity is a fundamental part of the skill acquisition process, resulting in the largely effortless, automatic, and efficient (although in our present example perhaps erroneous, or at least suboptimal) execution of movement (Fitts & Posner, 1967). There are many advantages of automaticity when performing motor skills. For example, it enables attention to be directed towards changeable shot, weather, and game conditions without having to also overly focus on controlling the movement components (not that attention paid internally towards the movement always results in a negative outcome; refer Bortoli et al., 2012). Briefly, because attentional capacity is finite, automatization releases resources to focus on task-relevant information. In the short term, automaticity even prevents golfers from stabilizing what would normally be considered ineffective technique for the majority of shots experienced: when, for instance, executing from a severely steep incline or hitting out from underneath a bush. Therefore, the important message here is that the most practised technique, rather than the most recent technique, is the version most likely to persist within a golfer's repertoire.

Accordingly, skill refinement should be considered a high-risk intervention and distinct from skill acquisition (i.e., developing automaticity) and performance (i.e., exploiting already existing levels of automaticity), due largely to the competition associated with a golfer's already well-established technique (Kostrubiec et al., 2006). In fact, the more experienced the golfer is at executing a technique and/or the greater the number of changes made previously (a distinct possibility if frequently switching coaches), the stronger/greater number of sources of competition there will be. It is on this basis that critique is warranted towards several proposals within the literature that suggest that strategies for skill acquisition and performance can be and/or are applicable to the experienced athlete when making a refinement. Specifically, consider the use of an external focus of attention (i.e., directing attention away from body movement; Wulf, 2016) and implicit motor learning (i.e., practising a skill without accruing explicit knowledge of the movement; Masters, 1992; Rendell et al., 2011). Notably, both approaches have also recently been challenged regarding their usefulness and application outside of the experimental setting and for sports requiring a variety of complex skills (refer Gabbett & Masters, 2011, Toner & Moran, 2015); but, in the present context, this critique will be limited purely to occasions of refinement.

By definition, both strategies involve not consciously attending to any body movements in an effort to prevent interference with automatic, subconscious execution processes (McNevin et al., 2003). Furthermore, implicit learning aims to inhibit explicit knowledge generation about the skill and, therefore, prevent the possibility of conscious reinvestment and skill breakdown under high-anxiety conditions (Masters & Maxwell, 2008). However, should the golfer's automatized control remain unchanged, it would be difficult to see how small refinements could be made long-term permanent and pressure-resistant since the already well-established version would continue to exert strong competition. Moreover, even if a skill were to be already acquired via implicit training, how would a technique change even work using additional implicit methods? Coaches should be cautious when observing apparent success during coaching sessions with the said approaches, since often these can be lost after a short break or when attempting to transfer the new move onto the golf course. Moreover, the consistency of a movement's automaticity explains this occurrence (Carson & Collins, 2016a), with

some suggesting that the skill acquisition process be beneficially prevented from achieving full automatization across the entire movement; in other words, too much automatization is a bad thing (cf. Toner & Moran, 2015). Indeed, this would certainly concur with characteristics of elite-level athletes' performances (e.g., Nyberg, 2015; Christensen et al., 2016), which provide the possibility to access skill components should they be necessary to maintain performance of a task at hand (e.g., intentionally execute a draw rather than a fade), and, therefore, counter any long-term advantages of always executing with an external focus of attention or under an implicit design. In summary, the proposal that one type of motor control strategy is absolutely beneficial for acquiring, performing, and refining motor skills is absolutely unrealistic and undesirable in absolutely every case. In short, it depends!

Alternatively, successful skill refinement requires a non-linear, transitory process. Notably, the Five-A Model proposed by Carson and Collins (2011) – a five-stage process designed to promote long-term permanence and pressure resistance – expressly encourages conscious deautomatization of the technical aspect (not every aspect of movement) requiring modification within the early 'awareness' stage (Christina & Corcos, 1988; Beilock et al., 2002; Oudejans et al., 2007). That is, of course, having already conducted a case formulation to decide whether refinement is necessary, what to refine, how, why, and when during the previous stage of 'analysis' (cf. the previous section). Accordingly, the golfer actively retrieves, through a narrow internal focus of attention, the flawed aspect of the memory representation and inevitably experiences a temporary regression in motor control. Such practice is, therefore, entirely counter to implementing a completely external focus of attention or implicit strategy (e.g., dual-task condition), but essential if it is to undergo permanent modification.

Of course, deautomatization can be very frustrating for the golfer as performance dips (Carson & Collins, 2016b). Therefore, it is crucial to ensure buy-in and trust between golfer and coach, as described in the previous section. Indeed, a thorough analysis would have confirmed that a golfer was 'change-ready', equipped with the mental skills to employ the required techniques (e.g., internal imagery), and sufficiently well supported by their caddie, psychologist, family, manager, teammates, and/or friends to maintain focus on and motivation for the job at hand. Given the potential for mixed messages within a close multi-stakeholder environment, however, the coach would be wise to set ground rules regarding role clarity and interaction among the support team (Collins & Collins, 2011). Indeed, a disruptive effect is easily misunderstood as poor coaching to the uninformed golfer, so consistent messages can help to enhance a subjective norm (Ajzen, 1991) and intention to stay committed.

Empirically, available data demonstrate the reality of this awareness process as not necessarily being immediate within the training session (Carson & Collins, 2015). Instead, golfers may need several sessions of focussed effort to fully deautomatize the targeted swing aspect. The primary aim at this stage, however, is not the modification of movement, but simply to deautomatize the movement's control as a 'kick start' to the process.

To assist in this goal, studies (e.g., Collins et al., 1999; Hanin et al., 2002; Carson et al., 2014) have supported the use of contrast training (i.e., purposefully alternating between the flawed and desired version techniques) concurrently with intentional cueing and direct questioning. Not only does this approach call the established version into consciousness, it also generates a targeted new version – although initially weak (relative to the existing version) – within the motor memory trace. Additionally, Carson et al. (2016) showed that several found it more effective to consciously initiate refinements when hitting in front of a net versus onto an outdoor driving range, thereby reducing environmental distractions to permit a more internally directed and less outcome-oriented focus. While such practice might not be the case for all golfers, empirical study is yet to confirm this. Data certainly support the former contention, in that lower

inter-trial movement variability of individually targeted refinements was found in the former condition, thus indicating a higher level of conscious control.

So, if using the Five-A Model, having deautomatized the erroneous technique and created the realization of what needs to change, progress is required through a gradual stage of 'adjustment' in which the new version of the technique becomes more accurate, comfortable, and accepted while concurrently representing a distinct 'departure' from the original, unwanted movement. Such an effect relies on increasing the practice volume of the new version by tapering out contrasts with the original and reintroducing more representative golf environments (e.g., driving range/golf course). Presenting a best-attempt self-model (e.g., on an electronic tablet; Carson & Collins, 2015) at this stage can prime the golfer and drive the modification of the memory representation, as well as provide a source of motivation (Carson et al., 2014). Once consistently achieved, gradual reautomatization must take place through a reduction of conscious control towards the targeted technical aspect, within the '(re)automation' stage. This process allows for the less-associated aspects of the refinement to 'settle in' with the new version of the skill, whereby the entire movement is primed holistically through patterns of rhythmic thought (e.g., mood words), therefore acting as a 'source of information' (MacPherson et al., 2008, p. 289). MacPherson et al. (2009) also explain such cognitions as providing a 'screen' from potentially maladaptive thoughts, that is, a positive distraction. Finally, as a proactive step, the skill must be pressure-proofed against all weathers, including negative symptoms of anxiety. Combination training (Collins et al., 1999; Carson & Collins, 2015), that is, combining physical exertion with a high degree of technical challenge, has been employed to offer the double benefit of increased performance outcome and perceived proficiency.

Notably, there are many factors to consider during use of the Five-A Model, too many to cover in detail here. As such, we recommend interested readers to other informative texts (refer Hanin et al., 2002; Carson & Collins, 2011; Toner et al., 2012; Carson & Collins, 2014, 2016b). What we hope to have achieved, however, is a position against a 'one size fits all' approach.

### Implications for the game

Given the need for such a comprehensive approach to refining skills, there are clearly many significant implications, including the training of the coach, the use and integration of any support specialists, and the prerequisite characteristics of the golfer. Addressing the former, a PJDM approach will focus on generating a case formulation, as well as implementing and auditing working practice, therefore requiring a sufficiently broad declarative and procedural understanding of sport sciences as a whole. The effective coach will not solely specialize; rather, training must facilitate knowledge across the '-ologies' and be in context for optimum impact. Coaches will be encouraged and provided with a range of opportunities to think critically when evaluating research/evidence-based practice, discover the important factors that coaching decisions depend on, and conduct meaningful, light-on-description self-reflections referencing their intention for impact, with ongoing auditing processes involved. Indeed, these components will form an important aspect of coach accreditation, with frequent, less-formal, and articulated justification characterizing the style of interaction between assessor and coach. The authors suggest that the development of both macro and metacognitive skills in this way provides a stronger basis for lifelong development and an overall more capable workforce.

The use and integration of support team dynamics will also have strong implications. Indeed, it is not uncommon for the too many ologists involved – each with their own working agenda, desire to prove their discipline's worth, and understanding of the issue – to create unwanted

conflict (Collins et al., 2015b). While critical debate is of course a positive characteristic of high-performance environments (Burke, 2011), it must be carefully mediated by the coach at the right times to ensure that it offers only a beneficial impact to both the intervention design and auditing process. In fact, such appreciation also applies to other stakeholders, such as management staff, especially at the elite level, who often have the final say when it comes to finances and support provision. Ideally, the support team will function with a shared understanding and common goals, putting the golfer at the forefront of any decision made. As such, collaboration with, for instance, performance institutes, must be oriented for golf. Presentation of ideas and feedback to the golfer must be consistent, even if there exist hard-core debate and discussion behind the scenes. Therefore, establishing role clarity before the refinement is initiated is increasingly important to knowing exactly who does what, with whom, and when.

From the golfer's perspective, technical refinement can be characterized as a transition. Since transitions often present a significant degree of difficulty and challenge (Collins & MacNamara, 2012), it is important that golfers can overcome any trauma imposed. Indeed, recent talent development research has identified several psychobehavioural skills (Psychological Characteristics for Developing Excellence; MacNamara et al., 2010a) that, when developed for and deployed at, these critical periods assist athletes to successfully negotiate the inevitable rocky road ahead. Indeed, exemplar characteristics include resilience, imagery, commitment, coping under pressure and with setbacks, goal setting, and social skills (Kamin et al., 2007; MacNamara et al., 2008; Sarkar & Fletcher, 2014). Accordingly, as a precursor to implementing refinement, coaches should ensure that golfers are sufficiently prepared during the skill acquisition process, through the development of these skills, to overcome known future transitions such as injury, expectations of playing in higher-status teams/Tours, and technical refinement. Notably, while these specific characteristics are yet to be empirically tested as holding relevance during skill refinement with experienced athletes, current work in golf suggests elements of self-presentation bias and confidence in using mental imagery, at least, have a significant impact on the level of intervention outcome (Carson & Collins, 2015).

### Summary and future directions

This chapter has challenged coaches and researchers to consider new perspectives when helping golfers refine already long-practised and well-established skills. Fundamentally, this has meant acknowledging the limitations of skill acquisition and performance knowledge for use during this starkly different task. Additionally, there is a need to broaden the application of coaches' (and other stakeholders', including management at the elite level) understanding to cater for inherent and complex biopsychosocial interactions (this latter point also being pertinent to skill acquisition and performance outcomes). Therefore, the use of an expertise (PJDM) approach was suggested as an alternative to acting on a competency-driven basis. It is not anticipated that such a transition could be easy within the golf-coaching profession, especially considering its long-standing and historic roots: it will require a significant change in culture, development, and assessment structure, as well as service provision for some coaches working with some players. Accordingly, future work should seek to assess the meta and macrocognitive skills of coaches as exemplar standards of practice at different stages of professional development and when working towards different player outcomes. Equally, there is a need for greater testing of the Five-A Model with a range of golfers and a range of intended technical changes. While research to date has explored many of its elements, including longitudinal tracking, greater attention towards its validation would be much welcomed. Finally, any innovations that golf development bodies can implement towards growth in this area of research and practice are awaited with much interest.



## References

- Ajzen, I. (1991) The Theory of Planned Behavior, *Organizational Behavior and Human Decision Processes*, 50 (2), 179–211.
- Beilock, S.; Bertenthal, B.; McCoy, A. & Carr, T. (2004) Haste Does Not Always Make Waste: Expertise, Direction of Attention, and Speed Versus Accuracy in Performing Sensorimotor Skills, *Psychonomic Bulletin & Review*, 11 (2), 373–379.
- Beilock, S.; Carr, T.; Macmahon, C. & Starkes, J. (2002) When Paying Attention Becomes Counterproductive: Impact of Divided Versus Skill-Focused Attention on Novice and Experienced Performance of Sensorimotor Skills, *Journal of Experimental Psychology: Applied*, 8 (1), 6–16.
- Bortoli, L.; Bertollo, M.; Hanin, Y. & Robazza, C. (2012) Striving For Excellence: A Multi-Action Plan Intervention Model for Shooters, *Psychology of Sport and Exercise*, 13 (5), 693–701.
- Burke, V. (2011) Organizing for Excellence, In: D. Collins; A. Button & H Richards, (Eds.) *Performance Psychology: A Practitioner's Guide*, Oxford, UK: Elsevier.
- Burwitz, L.; Moore, P. & Wilkinson, D. (1994) Future Directions for Performance-Related Sports Science Research: An Interdisciplinary Approach, *Journal of Sports Sciences*, 12 (1), 93–109.
- Carr, D. (1999) Professional Education and Professional Ethics Right to Die or Duty to Live? *Journal of Applied Philosophy*, 16 (1), 33–46.
- Carson, H. & Collins, D. (2011) Refining and Regaining Skills in Fixation/Diversification Stage Performers: The Five-A Model, *International Review of Sport and Exercise Psychology*, 4 (2), 146–167.
- Carson, H. & Collins, D. (2014) Effective Skill Refinement: Focusing on Process to Ensure Outcome, *Central European Journal of Sport Sciences and Medicine*, 7 (3), 5–21.
- Carson, H. & Collins, D. (2015) Tracking Technical Refinement in Elite Performers: The Good, the Better, and the Ugly, *International Journal of Golf Science*, 4 (1), 67–87.
- Carson, H. & Collins, D. (2016a) The Fourth Dimension: A Motoric Perspective on the Anxiety-Performance Relationship, *International Review of Sport and Exercise Psychology*, 9 (1), 1–21.
- Carson, H. & Collins, D. (2016b) Implementing the Five-A Model of Technical Change: Key Roles for the Sport Psychologist, *Journal of Applied Sport Psychology*, 28 (4), 392–409.
- Carson, H.; Collins, D. & Jones, B. (2014) A Case Study of Technical Change and Rehabilitation: Intervention Design and Interdisciplinary Team Interaction, *International Journal of Sport Psychology*, 45 (1), 57–78.
- Carson, H.; Collins, D. & Macnamara, Á. (2013) Systems for Technical Refinement in Experienced Performers: The Case From Expert-Level Golf, *International Journal of Golf Science*, 2 (1), 65–85.
- Carson, H.; Collins, D. & Richards, J. (2016) Initiating Technical Refinements in High-level Golfers: Evidence for Contradictory Procedures, *European Journal of Sport Science*, 16 (4), 473–482.
- Christensen, W.; Sutton, J. & Mcilwain, D. (2016) Cognition in Skilled Action: Meshed Control and the Varieties of Skill Experience, *Mind and Language*, 31 (1), 37–66.
- Christina, R. & Corcos, D. (1988) *Coaches Guide to Teaching Sport Skills*, Champaign, IL: Human Kinetics.
- Collins, D. & Collins, J. (2011) Putting Them Together: Skill Packages to Optimize Team/Group Performance, In: D. Collins; A. Button, & H. Richards (Eds.) *Performance Psychology: A Practitioner's Guide*, Oxford, UK: Elsevier.
- Collins, D. & Kamin, S. (2012) The Performance Coach, In: S. Murphy (Ed.) *The Oxford Handbook of Sport and Performance Psychology*, New York, NY: Oxford University Press.
- Collins, D. & MacNamara, Á. (2012) The Rocky Road to the Top: Why Talent Needs Trauma, *Sports Medicine*, 42 (11), 907–914.
- Collins, D.; Burke, V.; Martindale, A. & Cruickshank, A. (2015a) The Illusion of Competency Versus the Desirability of Expertise: Seeking a Common Standard for Support Professions in Sport, *Sports Medicine*, 45 (1), 1–7.
- Collins, D.; Carson, H. & Cruickshank, A. (2015b) Blaming Bill Gates AGAIN! Misuse, Overuse and Misunderstanding of Performance Data in Sport, *Sport, Education and Society*, 20 (8), 1088–1099.
- Collins, D.; Doherty, M. & Talbot, S. (1993) Performance Enhancement in Motocross: A Case Study of the Sport Science Team in Action, *The Sport Psychologist*, 7 (3), 290–297.
- Collins, D.; Morriss, C. & Trower, J. (1999) Getting It Back: A Case Study of Skill Recovery in an Elite Athlete, *The Sport Psychologist*, 13 (3), 288–298.
- Collins, L. & Collins, D. (2015) Integration of Professional Judgement and Decision-making in High-Level Adventure Sports Coaching Practice, *Journal of Sports Sciences*, 33 (6), 622–633.
- Fitts, P. & Posner, M. (1967) *Human Performance*, Belmont, CA: Brooks/Cole Publishing Company.
- Gabbett, T. & Masters, R. (2011) Challenges and Solutions When Applying Implicit Motor Learning Theory in a High Performance Sport Environment: Examples From Rugby League, *International Journal of Sports Science and Coaching*, 6 (4), 567–575.
- Gentile, A. (1972) A Working Model of Skill Acquisition with Application to Teaching, *Quest*, 17 (1), 3–23.
- Giacobbi, P., Jr.; Poczwadowski, A. & Hager, P. (2005) A Pragmatic Research Philosophy for Applied Sport Psychology, *The Sport Psychologist*, 19 (1), 18–31.
- Hanin, Y.; Korjus, T.; Joste, P. & Baxter, P. (2002) Rapid Technique Correction Using Old Way/New Way: Two Case Studies with Olympic Athletes, *The Sport Psychologist*, 16 (1), 79–99.
- Kamin, S.; Richards, H. & Collins, D. (2007) Influences on the Talent Development Process of Non-classical Musicians: Psychological, Social and Environmental Influences, *Music Education Research*, 9 (3), 449–468.
- Kostrubiec, V.; Tallet, J. & Zanone, P.-G. (2006) How a New Behavioral Pattern Is Stabilized with Learning Determines Its Persistence and Flexibility in Memory, *Experimental Brain Research*, 170 (2), 238–244.
- MacNamara, Á. & Collins, D. (2015) Twitterati and Paperati: Evidence Versus Popular Opinion in Science Communication, *British Journal of Sports Medicine*, 49 (19), 1227–1228.
- MacNamara, Á.; Button, A. & Collins, D. (2010a) The Role of Psychological Characteristics in Facilitating the Pathway to Elite Performance Part 1: Identifying Mental Skills and Behaviors, *The Sport Psychologist*, 24 (1), 52–73.
- MacNamara, Á.; Collins, D. & Button, A. (2010b) The Role of Psychological Characteristics in Facilitating the Pathway to Elite Performance Part 2: Examining Environmental and Stage-Related Differences in Skills and Behaviors, *The Sport Psychologist*, 24 (1), 74–96.
- MacNamara, Á.; Holmes, P. & Collins, D. (2008) Negotiating Transitions in Musical Development: The Role of Psychological Characteristics of Developing Excellence, *Psychology of Music*, 36 (3), 335–352.
- MacPherson, A.; Collins, D. & Morriss, C. (2008) Is What You Think What You Get? Optimizing Mental Focus for Technical Performance, *The Sport Psychologist*, 22 (3), 288–303.
- MacPherson, A.; Collins, D. & Obhi, S. (2009) The Importance of Temporal Structure and Rhythm for the Optimum Performance of Motor Skills: A New Focus for Practitioners of Sport Psychology, *Journal of Applied Sport Psychology*, 21 (S1), 48–61.
- Mallett, C. & Pyke, F. (2008) Coaching the Best, *Sports Coach*, 30 (1), 6–8.
- Masters, R. (1992) Knowledge, Knerves and Know-how: The Role of Explicit Versus Implicit Knowledge in the Breakdown of a Complex Motor Skill Under Pressure, *British Journal of Psychology*, 83 (3), 343–358.
- Masters, R. & Maxwell, J. (2008) The Theory of Reinvestment, *International Review of Sport and Exercise Psychology*, 1 (2), 160–183.
- Maxwell, J.; Masters, R. & Eves, F. (2000) From Novice to No Know-how: A Longitudinal Study of Implicit Motor Learning, *Journal of Sports Sciences*, 18 (2), 111–120.
- McNevin, N.; Shea, C. & Wulf, G. (2003) Increasing the Distance of an External Focus of Attention Enhances Learning, *Psychological Research*, 67 (1), 22–29.
- Nash, C.; Martindale, R.; Collins, D. & Martindale, A. (2012) Parameterising Expertise in Coaching: Past, Present and Future, *Journal of Sports Sciences*, 30 (10), 985–994.
- Nyberg, G. (2015) Developing a “Somatic Velocimeter” – The Practical Knowledge of Freeskiers, *Qualitative Research in Sport, Exercise and Health*, 7 (1), 109–124.
- Oudejans, R.; Koedijker, J. & Beek, P. (2007) An Outside View on Wulf's External Focus: Three Recommendations, *E-Journal Bewegung Und Training* [Online], 1, Available at www.Ejournal-But.De.
- Prochaska, J. & Prochaska, J. (1999) Why Don't Continents Move? Why Don't People Change? *Journal of Psychotherapy Integration*, 9 (1), 83–102.
- Rendell, M.; Farrow, D.; Masters, R. & Plummer, N. (2011) Implicit Practice for Technique Adaptation in Expert Performers, *International Journal of Sports Science and Coaching*, 6 (4), 553–566.
- Sarkar, M. & Fletcher, D. (2014) Psychological Resilience in Sport Performers: A Review of Stressors and Protective Factors, *Journal of Sports Sciences*, 32 (15), 1419–1434.
- Schack, T. & Bar-Eli, M. (2007) Psychological Factors of Technical Preparation, In: B. Blumenstein; R. Lidor, & G. Tenenbaum (Eds.) *Psychology of Sport Training*, Münster, Germany: Meyer & Meyer Sport, pp. 62–103.

*Howie J. Carson and Dave Collins*

- Toner, J. & Moran, A. (2015) Enhancing Performance Proficiency at the Expert Level: Considering the Role of "Somaesthetic Awareness", *Psychology of Sport and Exercise*, 16 (Pt 1), 110–117.
- Toner, J.; Nelson, L.; Potrac, P.; Gilbourne, D. & Marshall, P. (2012) From "Blame" To "Shame" in a Coach–Athlete Relationship in Golf: A Tale of Shared Critical Reflection and the Re-Storying of Narrative Experience, *Sports Coaching Review*, 1 (1), 67–78.
- Winter, S. & Collins, D. (2016) Applied Sport Psychology: A Profession? *The Sport Psychologist*, 30 (1), 89–96.
- Wulf, G. (2016) An External Focus of Attention is a *Conditio Sine Qua Non* for Athletes: A Response to Carson, Collins, and Toner (2015), *Journal of Sports Sciences*, 34 (14), 1293–1295.