The prevalence and influence of psychosocial factors on technical refinement amongst highly-skilled tennis players

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Abstract

The present study investigated the prevalence and influence of *psychosocial* factors amongst a sample of highly-skilled athletes who had previously attempted to refine their technique. Semi-structured qualitative interviews were conducted with eight tennis players to gain an in-depth understanding of their experiences during the process. Results revealed that participants sought to refine their technique in order to address an 'attenuated' movement pattern perceived as causing a competitive disadvantage. Addressing the psychosocial factors of interest here, commitment and confidence were reportedly important concomitants during the refinement process. Upon reflection, participants indicated that taking a break from competition and dedicating more time to the refinement might have increased the likelihood of effective change and performance improvement. Overall, findings indicate that psychosocial factors have a significant influence on players' ability to successfully enact technical refinement. However, it is suggested that greater consideration towards other motoric factors could also have improved levels of success. In conclusion, while the importance *for* change was understood, there is a need for improved understanding and planning in terms of how a coach might operationalize these factors within training for the competition environment.

Keywords

Commitment, Confidence, Expertise, Five-A Model, Sports coaching.

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Longitudinal sporting involvement at the highest level is most typically depicted as a nonlinear pathway, beset by challenges that should be identified, prepared for, and then, hopefully, negotiated; usually with varying degrees of success (MacNamara, Button, & Collins, 2010). Indeed, effectively confronting such challenges can be *frustrating* for athletes at any performance level, due to the destabilizing effect they can impart. As such, athletes may benefit from support and guidance from a coach and/or sport psychologist. Exemplar challenges reported within the literature include athletes transitioning between sports (MacNamara & Collins, 2015), returning from injury (Podlog & Dionigi, 2010) and making refinements to already long-practiced and well-established motor skills (Hanin, Korjus, Jouste, & Baxter, 2002). Crucially, scholars identified the deployment of key psychosocial skills (e.g., psychological characteristics of developing excellence or PCDEs) as being essential in facilitating the *transition* through, and optimising benefits from, these disruptive times (MacNamara et al. 2010; Orlick, 1990). It is, therefore, of interest to understand the different contexts in which these skills are utilised and how applied science support might be structured and implemented to optimise the experience through this “rocky road” (Collins & MacNamara, 2012). Therefore, reflecting the current scarcity of research addressing this topic during periods of technical refinement, and recent recognition of its importance within the field of applied sport psychology, the current study focused on exploring the prevalence and influence of psychosocial factors during the refinement process amongst highly-skilled performers (Carson & Collins, 2016).

Exemplifying the high-risk nature of technical refinement, anecdotal reports from highly-skilled performers document the difficulties one may face in completing this task. For instance, Luke Donald, the former world number one ranked golfer attempted to refine his

swing in order to improve the chances of winning his first major championship. Unfortunately, this process was unsuccessful and Donald dropped to a world ranking of 96 (end of year world ranking of 140 in 2017) subsequently explaining that: “it was a big alteration but I thought I could do it as I’ve always considered myself a fast learner. But I can see how difficult it is to break down 30 years of golfing DNA” (Corrigan, 2014). Indeed, this self-reflection highlights an important distinction between initial *learning* and later *refinement*, suggesting that processes involved in one might not be *directly* applicable to the other (Carson & Collins, 2011). Carson and Collins (2015) recently documented accounts of unsuccessful refinement resulting, in part, from concomitant psychosocial factors including a failure to “buy-in” to the prescribed change. Such empirical evidence suggests that altering well-established motor skills involves a degree of risk given that performers are required to “de-chunk” a proceduralized movement pattern before reautomatizing the movement to be performed subconsciously (Beilock, Carr, MacMahon, & Starkes, 2002).

In seeking to address this issue, the Five-A Model of technical refinement has been proposed as an interdisciplinary guide for coaches and support specialists, when working with performers to refine their already long-practiced and well-established motor skills (Carson & Collins, 2011). Using a pragmatic and nonlinear approach, the model synthesises many different evidence-bases into a five-stage framework (for a detailed description of the entire model and its theoretical underpinning see Carson & Collins, 2011, 2016). To provide an overview of these stages, their designed purpose and exemplar references to support the use of each stage, see Table 1.

Insert Table 1 about here

Significantly, during the model's formation, these authors identified a number of concomitant *psychosocial* factors (i.e., mental states, psychological characteristics, and aspects of the social environment) that impact upon success. According to these researchers, the psychosocial factors likely to have the greatest bearing on refinement success include an athlete's *involvement*, *commitment*, *trust* and *confidence*. For example, involvement in the process may be crucial for establishing athlete buy-in (Kidman & Lombardo, 2010). Previous research revealed that adherence to technical refinement is enhanced when coaches encourage their athletes to help diagnose and plan an appropriate intervention targeting the cause of the inefficient movement pattern (Carson & Collins, 2015). Moreover, buy-in was particularly evident when the performer understood the rationale for training practices and how these were positively different to previously unsuccessful attempts to refine their technique.

Commitment is also believed to play a hugely important role in athletic development since it directly influences an athlete's involvement and persistence in a given activity (Weiss & Weiss, 2006). Moreover, commitment has a strong relationship with levels of intrinsic motivation (Zahariadis, Tsorbatzoudis, & Alexandris, 2006) and mental toughness (Clough, Earle, & Sewell, 2002). To illustrate, researchers found that commitment (e.g., leading to perseverance at challenging times) facilitated the successful development of athletes from initial involvement to achieving and maintaining a world-class status (MacNamara et al., 2010). Trust is also important in at least two respects, firstly during the execution of the motor skill to enable higher levels of automaticity and, secondly, within the athlete–coach relationship. The level of trust that the athlete places in his/her coach's ability to oversee the process may influence his/her adherence to the prescribed technical change (see Toner, Nelson, Potrac, Gilbourne, & Marshall, 2012). Closeness (i.e., the emotional tone that coaches and athletes experience and express in describing their athletic relationships) is

characterized by mutual trust and this has been found to play an important role in an athlete's development as a performer and a person (Jowett & Cockerill, 2003).

Finally, the confidence that athletes possess in their ability to consistently execute the new movement pattern may have an important bearing on the technical change process. High levels of sport confidence are believed to facilitate performance proficiency through their positive effect on athlete's cognitions, affects and behaviours, while low self-confidence is associated with negative effect, defective cognitions and ineffective behaviours (Beaumont, Maynard, & Butt, 2015; Hays, Thomas, Maynard, & Bawden, 2009). Relatedly, athletes' self-efficacy to refine their technique is likely to be influenced by a number of sources of information, including: their mastery or performance experiences (e.g., previous occasions when they have attempted to enact change), their vicarious experiences (e.g., whether anyone in their stable of athletes has successfully refined their technique), any verbal persuasion they may have been subjected to by coaches and their physiological and emotional states (Bandura, 1977). Although the constructs of *trust* and *confidence* bear conceptual similarities, an athlete's trust in their coach assumes that they are confident in his/her qualities (based on the trust giver's expectations of the coach's future behaviours), while confidence in one's ability to successfully refine technique does not imply trust in the coach's ability to oversee the process.

Despite the apparent ubiquity of technical refinement within the applied setting, research has yet to explore whether the concomitant *psychosocial* factors identified by the Five-A Model and/or others (resilience), might underpin successful and unsuccessful cases of technical refinement. This is an important issue to address, as equipping athletes with a range of positive psychosocial assets (e.g., realistic performance evaluations, coping with pressure, self-awareness) will assist both their performance and personal development (Abbott & Collins, 2004; Harwood, 2008; MacNamara et al., 2010; Nicholls, Taylor, Carroll, & Perry,

2016). Therefore, the principal aim of this exploratory study was to identify the prevalence and influence of these factors by conducting interviews with highly-skilled tennis players who had previously attempted to refine a well-established movement pattern.

Method

Philosophical orientation

The study was grounded in a post-positivist paradigm (Guba & Lincoln, 2005). This had a number of implications for our study including our ontological (i.e., critical realism) and epistemological stance (i.e., modified dualist/objectivist), our choice of method (i.e., interviews that were informed by existing literature), data collection (i.e., single interviews), data analysis (e.g., calculating the number of participants who represented each theme), trustworthiness techniques (e.g., peer debriefing) and representation of the findings (i.e., realist form characterized by experiential authority, the participant's point of view and conveying interpretive omnipotence).

Participants

Six males and two females aged between 19–30 years (M_{age} = 23.5, SD = 4.3) with experience of attempting to refine their technique within the last 5 years participated in this study. Participants had spent between 1 to–4 years working on the refinement, with all but two athletes training alongside different coaches. Retrospective in-depth interviews are commonly employed by qualitative researchers (e.g., Swann, Crust, Keegan, Piggott, & Hemmings, 2015) and were required in the current context since participants and coaches are often reluctant to discuss the refinement process as it unfolds for fear that this might hinder the athlete's ability to successfully enact change. Researchers have argued, however, that athletes are capable of remembering significant life events a long time after their occurrence (Gould, Finch, & Jackson, 1993). Participants were identified via purposive and snowball sampling. A purposive sample of athletes was sought which entailed those who had

competed at an advanced level (i.e., national events and had a Lawn Tennis Association rating of 3.1 or below) at the time of the technical refinement. According to Swann, Moran, and Piggott's (2015) taxonomy of expertise, our sample are representative of semi-elite athletes as they participate just below the top standard possible in their sport (i.e., talent-development programmes). Likewise, they may also be considered as participating along the Elite Referenced Excellence pathway (Collins et al. 2012). Electronic-mail was used to contact potential participants within the United Kingdom. Once initial contact had been made with athletes, we then used snowball sampling; a strategy where further participants are identified from existing participants (Patton, 2002). Ethical approval was granted by the University ethics committee and all participants provided signed informed consent prior to data collection.

Insert Table 2 about here

Procedure

Each participant took part in an in-depth, face-to-face interview. Interview locations and times were selected at the convenience of each participant. The interview guide was informed by the work of scholars in the field of technical refinement (e.g., Carson & Collins, 2011) and covered three topics to address the study's aims: (a) *why* the athlete decided to refine their technique and *what* components of technique were refined, (b) the *moderators* of change (i.e., the psychosocial factors that influenced the refinement process) and (c) the participants' *reflections* upon the whole process (what, if anything, they might do differently if they were to go through this process again and, consequently their recommendations for coaches). Accordingly, the interview used a structured and standardized format in order to address time periods pre, during and post refinement. While participants were asked the

same questions in the same way, the sequence of questions varied according to the flow of the conversation and follow-up probes were used in order to elaborate (e.g., “Could you please explain that in more detail?”) and clarify (e.g., “What do you mean by that?”) some responses. This approach helped establish rapport and allowed for greater depth of information to be collected. Interviews lasted between 55–95 minutes, were recorded in mp3 file format and later transcribed verbatim.

Data Analysis

Following transcription of the interviews, we conducted a content analysis involving three stages to this process (Patton, 2002). First, transcribed interviews were read several times to gain a clear comprehension of the participants’ responses and subjected to line-by-line analysis to identify raw data codes. Second, we used a combination of inductive and deductive approaches to identify meaning units which were subsequently grouped together to form emergent categories (lower-order themes) based on their similarity to each other and distinction from other categories (Patton, 2002). This process was then repeated in order to generate higher-order themes. Next, higher-order themes were organized to form a chronological representation (i.e., from the start to finish) of participants’ experiences of the technical refinement process. As such, higher-order themes were placed deductively into the pre-determined dimensions of pre-change, in-change and post-change evaluation. Comparative analysis was used to identify common themes across participants and, in line with our philosophical stance, a frequency analysis was conducted to illustrate the number of participants representing each theme (see Table 3).

Trustworthiness

We employed both peer debriefing and member checking as a means of enhancing the rigour of the findings. Peer debriefing acts as an external check on the research process while member checking is used to establish the credibility of the findings and interpretations

(Creswell, 2007). The first and fourth author started this process by identifying common themes from the transcripts independently and then acted as critical friends (Faulkner & Sparkes, 1999). Here, the authors questioned each other's interpretations, refined emergent themes and ensured that personal experiences or beliefs did not unduly bias the findings. There was a high level of agreement between the authors, with only a small number of minor discrepancies (less than 5% of data codes) requiring adjustment or further rationale. The identified themes were then discussed with and challenged by the second and third author until a consensus was reached. Next, using an approach based on synthesised member checking (see Birt, Scott, Cavers, Campbell, & Walter, 2016), participants were sent their results and asked to confirm whether or not they were an accurate representation of their experiences. No changes were made at this point.

Results

The first section addresses why athletes decided to make a technical refinement and what aspect of their movement they chose to refine; that is, the important considerations occurring prechange. Next, we outline key psychosocial moderators that influenced the extent to which the process was successful or unsuccessful. Finally, we present results relating to the perceived consequences of the technical refinement process, or in other words the "post-process review" (see Table 3).

Pre-change

Across participants, several different technical components were refined. Four players addressed their dynamic forehand movement, two changed their forehand grip, while two sought to change their backhand. Notably, all intended refinements were individually-specific; as would be expected at this high level, after the development of a well-established movement pattern.

All participants decided to make a technical refinement to improve their performance by altering what they, or their coach, considered to be an "attenuated" aspect of their movement. These players were aware that a feature of their game (e.g., backhand) was weak and was being targeted by opponents in competitive matches. The coach–athlete dyad reached a mutual decision that a technical refinement was required to address the issue. Six participants were quite explicit about their desire to achieve a world ranking or to compete at a higher level. Take, for example, Mike's comment that "throughout my whole time as a junior the aim was to try and get to a slam and we felt the changes to my game would get me there". Others recognized that they had a technical flaw that was likely to hold them back as they moved to a higher ratings band. For example, Matty revealed:

> I recognized that it was a problem because in matches I was finding it so hard to attack; because I could never be on the front foot . . . I was always making contact with the ball late, so I'd only be able to attack off real easy balls.

Similarly, Scott revealed, "basically my backswing was too big and I was getting caught out if someone hit the ball fast at me".

Insert Table 3 about here

In-Change: Psychosocial Factors that Influenced the Process

Commitment. The extent to which participants *committed* to the prescribed refinement had a hugely important bearing on its success. In the following section we discuss four specific factors (i.e., competitiveness, discomfort during competition, regulation of performance expectations, process vs. outcome goals) that influenced whether or not participants remained committed to technical refinement. Although all of the participants indicated that they were fully committed to the new movement in practice, this changed for

some during a competitive event. Here, a *competitive* urge to win appeared to override the desire to remain committed to trying the new movement. For example, Scott explained that he:

> Was sticking to the shape but it's almost the competitive side of you . . . . I wanted to win too much to be able to just to stay with it . . . I stuck with the new movement when I hit a top-spin forehand but I wouldn't say that I hit that many of them as I was trying to avoid hitting it.

John's competitive instincts led him to revert back to his old movement:

> My performance was significantly weak for me to go back to the original technique in the first match of a four match tournament . . . I was playing someone who I had preconceived notions that I was going to beat, the fact that I wasn't beating him and that it wasn't feeling good . . . . my natural instinct as a competitor and someone who has a fixed mindset and that I have to take care of this particular match, I can't consider losing this match so I have to change back.

Both of these players' commitment to the new movement was also influenced by the degree of *discomfort* they felt when first using it in competition. Scott felt that the new movement was:

> Awful, timing was off, wasn't really going in the court, there wasn't much power . . . my swing got very short, jittery almost and I wouldn't time it great because of that . . . I was just a sitting duck and thought I might as well hit a slice – I might be able to control that, I didn't feel comfortable with it at all.

Although Scott initially committed to the new technique, his level of discomfort was such that he ended up making "adjustments like playing around with my grip just trying to find a way to be able to hit it in the court with the new shape because I couldn't go back to the old

one". Significantly, although all of the participants found the new movement uncomfortable, not all of them reverted back to their old technique or experimented with different ways of performing the skill. In fact, as we discuss in the following sections, a number of coaches had persuaded their players that there was little point in doing so and convinced them that setbacks (which were characterized by feelings of extreme discomfort) were a natural part of the process.

Even though a number of participants struggled to commit to the new movement, four revealed that, despite initial setbacks in competition and the discomfort they experienced, they steadfastly committed to the prescribed refinement. Participants who *regulated their performance expectations* by accepting that it could take many months before they could successfully execute the new movement were more likely to commit to it in the long-term than those who thought the change could be made with long-term permanence quickly. Dave drew attention to the important role coaches play in this process when he suggested that "the coaches were saying it's going to take time . . . they re-iterated that to me so I felt under no pressure to quickly change it, I knew it was going to be a long period of time where I really had to focus".

In contrast, participants who failed to successfully enact change adopted unrealistic performance expectations; that is, they hoped that the process could be accomplished quite quickly. For example, Paul struggled to execute the new movement (although he eventually did almost 5 years after he started to make the change) because he was thinking of:

> The time limit . . . I was getting older . . . I knew I was almost on my way out of full-time tennis trying to make it. . . so I was thinking can we get this done as quickly as possible.

Commitment was enhanced by coaches who sought to remove pressure from their players by emphasizing that practice and competitive results were not important in the early

stages of the change process. Here, the coaches encouraged their athletes to focus on the *process* (i.e., getting the technique right) rather than the *outcome* and this helped them to accept that they were likely to make a large number of errors early on. Dave had a number of conversations with his coach which helped him realize that it was inevitable that he would:

> Hit a lot of errors but in my head I knew it was better going for it and making the errors than just running around it or hitting a slice and winning . . . because I won a couple of matches where I was like 'but yeah, you didn't do the right thing', so the winning and losing part became secondary, so it was all about the performance goals rather than the outcome goals.

Paradoxically, John revealed that his commitment to the new action was negatively influenced by the fact that he was so focused on the outcome of the action:

> I wasn't prepared to make even one forehand error . . . I created that mindset for myself where I wasn't allowed to make mistakes and to fail with it . . . I created a fear of making mistakes and a fear of losing.

Encouraging the players to focus on process rather than outcome goals also seems to have enhanced commitment by helping them to cope with anxiety experienced during this process. Mike noted how his coaches reassured him, "if you miss it's okay, make sure you are doing the right things" and "I bought into that so then the anxiety was taken away because I felt under no pressure to win or lose the match". In contrast, John, who struggled to make the change, mentioned that if he had worked closely with a coach (he saw coaches intermittently as part of a performance squad) it might have helped him through the process:

> It was kind of me by myself so to feel that I'd made that breakthrough was a really nice feeling to then having that blown apart in Day 1 and it was difficult not to have someone reassuringly say 'okay it's fine, it's part of a long-term process'.

In this case, a lack of psychological support left John "with less motivation to train over subsequent weeks . . . my motivation to commit to the change was lower".

Confidence. Participants' confidence in the process also had an important bearing on their ability to successfully enact change. Participant confidence was influenced by a number of specific factors, including; the belief they had in their coach's ability, belief in their own ability, competitive setbacks and positive feedback.

The belief they had in their coaches' ability meant that the majority of the participants were highly confident that the prescribed course of action would help them improve their games. In fact, it would seem that coaches had to do very little to get the players' buy-in for the refinement. Scott recalled when the idea was introduced to him that he felt:

> Pretty confident, I was just so happy with my tennis at the time and again because of the two people working with me I was like 'for sure this is going to work . . . it's not going to effect me'.

Similarly, Mike was hugely confident in the process because of his coach's previous experience: "at the time he was working with some other good players I felt like he'd gone through the process before – the way he delivered it to me". However, although all of the participants had a great deal of confidence in their coach, some lacked confidence in their *own ability* to make the change. Paul noted that he:

> Was going down there [to work with a new coach] to make it better . . . is there a perfect result? Every technique is different but I had the goal that I wanted to be happy with it . . . I wanted to be able to repeat it. Did I want a forehand as good as him [his coach]? Yeah but that wasn't achievable I don't think.

Interestingly, Paul's apparent lack of confidence in the process appears to have stemmed from his belief that he was, at 18 years of age, quite old to be making such a significant refinement which, if this genuinely *is* the case, raises the question of whether it is worth

attempting to make such a significant a change. John echoed similar sentiments when he revealed that he was only "moderately" confident "if I was to put it on a scale I'd say 60% probably . . . I had quite an awareness even at that stage of the science behind muscle memory and those kind of things . . . I knew these things take a lot of time".

Early *setbacks* in competitive events had a considerable impact on a number of the participants' confidence in the new technique. For example, John explained that:

> There had been an overall dent in my morale because of the way the tournament went and looking back that would have resulted in my training attitude being low . . . the morale of the change was dented, I kept going with it but with a different morale and motivation towards it . . . it was quite demoralizing really . . . I was thinking it couldn't have gone any better in practice the day before the tournament and I still couldn't do it so my confidence in it and my enjoyment of doing it would have been less in subsequent weeks.

Scott's confidence in the technique was also influenced by his initial experiences of using it in competition:

> I'd be going into a match when there were so many other things going on, different pressures, someone's trying to find ways to beat you, to pick holes in your game and it wasn't ready to stand up to that test at that time which maybe shot my confidence in that a little bit and in myself and in my own tennis.

These participants felt that setbacks may have arisen because they had spent an insufficient length of time automatizing their new action in practice before it was exposed to competitive pressure. Paul conceded that maybe things were progressed "a bit too quick so I hadn't built the foundation – so the hand feed I hadn't really perfected that and we're trying to rush it because I was still competing in competitions". Nevertheless, it is important to note that

389 although a number of participants lost a certain amount of confidence in their own ability to
390 bring about the technical refinement, they retained a great deal of confidence in their
391 coaches' ability throughout the process. That is, none of the players thought that they might
392 need to start working with someone else in order to improve performance, or even abort the
393 change process. In fact, a number of players discussed how coaches used *positive feedback*
394 to restore their confidence after they had experienced initial setbacks in competitions. For
395 example, although Matty discussed how "getting battered dented my confidence", in the
396 following weeks his coach:

397 > Spent a lot more time with me on squads . . . spent more time than he would have
398 > previously done . . . I kind of always felt he was watching even if he was at the other
399 > end of the centre . . . he'd appear from nowhere and tell me to slow it down a bit,
400 > speed it up a bit . . . his feedback gave me confidence that I was making progress.

401 After Michelle's new backhand technique was badly exposed in an important competition,
402 her coach told her "not to beat herself up about it" and that "she was making good progress".
403 This reassurance increased her confidence that she could successfully refine her technique in
404 the long-term. Although Scott initially struggled with the change, he revealed that his
405 relationship with his coach played an important role in helping him to eventually execute the
406 desired movement: "I still respect him an awful lot, I'd started to improve again, he got me
407 through it, they [both coaches] had been really positive and encouraging".

408 Participants who retained belief in their ability to refine their technique were working
409 with coaches who used a variety of other strategies to deliver positive feedback and develop
410 their confidence in the new technique. For example, as we noted in the previous section,
411 these coaches encouraged their players to focus on process rather than outcome goals. In
412 doing so, a number of coaches used recorded footage to show their players evidence that they
413 were achieving the desired movement positioning. Andrea felt that seeing this made it "clear

in my mind what I was doing and what I was aiming for" and that this enhanced her confidence that her action was improving in the desired direction.

Postchange Evaluation

Performance proficiency. Although four participants felt that the process had been unsuccessful, four participants declared it as an unqualified success even though each of them spent time struggling to adopt the new movement pattern. For example, Matty revealed that changing his forehand takeback eventually gave him "counter-punching ability . . . the court just felt bigger . . . as soon as it clicked I could recognize different situations and my feet were moving in the right way". For Mike, the new movement meant that he was:

> Back so quickly I was able to move the racket back and was therefore able to give myself time to get into position and hit a much cleaner ball. I could wait a split second and hit a top spin or I could just go full out and hit flat so there were two things that automatically were better.

In contrast, it was more difficult for the remaining four participants to determine whether the process had been successful. Interestingly, although none felt that their overall performance proficiency had regressed as a result of making the changes, three felt that it had taken too long before their new movement produced noticeably improved results. Unfortunately, these participants had reduced their commitment to competitive tennis, owing in part to the slow nature of their progress, to focus largely on coaching instead, by the time that they eventually became comfortable with the new movement.

Dedicate more time to practicing the new technique. In general, these participants felt that it had taken them a long time to acquire the desired technique due to an insufficient period of time being spent breaking the movement down and practicing it in a repetitive manner before they needed to use it in competition. However, they acknowledged that this was difficult given their tournament schedule at the time. For example, Paul argued that, "if

we'd stripped it back even more we probably would have done better. I think we would have done better if we'd hand fed and repeated that thousands of times, but I was 18 and still playing tournaments". While participants may need to increase the amount of time they dedicate to practicing the new technique, some authors have argued that there should be considerable behavioural correspondence between the practice and performance contexts in which the new technique will be used (e.g., as one of several examples, the practice environment presents the performer with functional or relevant action affordances; see Araújo & Davids, 2016).

Remain patient. These participants also discussed a number of things that they would do differently if they were to go through this process again. Four players spoke about the need to accept that they were engaged in a challenging process that would require them to remain extremely patient when inevitable setbacks arose. For example, John recommended that there should have been an:

> Environment where it's okay to lose . . . where I said I can have a free swing this tournament . . . I'm going to accept that I can see that this change is making me better . . . for the sake of 4 months down the line playing great tennis I'm going to be prepared to miss forehands this weekend.

Take a break from competition. Four participants are now full-time coaches and drew on this experience to consider what they would do differently if they were working with a player who they thought required a significant technical change. These participants noted that they would devote more time to helping the player get comfortable with the new movement before exposing it to the rigours of competition. Scott suggested that he was not sure if he should "have played tournaments so soon after making the change" and that a better approach may have been to "just get comfortable with it first before putting it into a match situation under pressure because it was getting torn apart". John expressed similar sentiments

464 when revealing what he would do if he were to coach a skilled player who was considering
465 making a technical change:

466 > I'd have to outline the risks and that we're going to need at least a minimum of a
467 > week training block and possibly two further weeks without competition where you'll
468 > play practice competition. Within that block you'd move from closed to open practice
469 > . . . closed points up until eventually playing full practice sets. Again, there's no
470 > pressure hitting it in or out, the only pressure is trying to maintain the technical goal
471 > and then maybe progress to a rally and then give them a specific shot to start the point
472 > off . . . no pressure at all and eventually moving to pressure and maybe put another
473 > player on the other side of the net where it's realistic.

474 Insert Table 4 about here

475 **Discussion**

476 The aim of this exploratory study was to identify the prevalence and influence of
477 psychosocial factors amongst a group of high-skilled athletes who had previously attempted
478 to refine their technique. This is the first study to provide a detailed account of tennis
479 players' experiences during the technical refinement process. The findings showed that
480 establishing and retaining athlete's *commitment* and *confidence* in the refinement, were
481 crucial in this regard, therefore justifying their inclusion within the Five-A Model (Carson &
482 Collins, 2011). Unfortunately, a failure to apply, or systematically cater for, these
483 psychosocial factors appeared to contribute to a number of unsuccessful outcomes too.
484 Similar to other highly-skilled athletes (Carson & Collins, 2016), the impact extended beyond
485 skill development possibilities to players' long-term involvement in competitive tennis. This
486 is one of the first studies to provide empirical support for the proposal that skill refinement
487 represents a significant and career defining transition along the performance pathway (Carson
488 & Collins, 2011; Toner & Moran, 2015). It is encouraging to note, however, that four

participants felt that the process had been extremely successful and that it had contributed to the improvement of their game. In the following sections we explain why the presence or absence of certain psychosocial factors may have contributed to successful or unsuccessful cases of technical refinement, and provide practical recommendations relating to *how* coaches, psychologists and athletes may apply these psychosocial behaviors.

A number of participants found it difficult to commit to technical refinement and either reverted back to their old technique or started to adopt a compromise technique (i.e., something "in-between" the old and the new movement) when first attempting the new movement in competition. These findings mirror the recent discovery that coaching interventions designed to refine the technique of European Tour golfers often led to a regression back to the original technique and that this was represented by fluctuations between automated and de-automated states (Carson, Collins, & MacNamara, 2013). Our results revealed that players who failed to commit were less likely to have regulated their expectations about the change and that they became frustrated and impatient when they realized the difficultly of this process. In line with findings from the empirical literature (e.g., MacNamara, Button, & Collins, 2010; Zahariadis, Tsorbatzoudis, & Alexandris, 2006), lower levels of commitment appear to have been accompanied by a reduction in intrinsic motivation and a failure to persevere with the chosen refinement. Coaches and psychologists may need to make athletes aware that initial setbacks, and the feelings of discomfort which characterize these events, are inevitable and that they should not be taken as evidence that change is not working, or that the chosen course of action is likely to hinder athlete development in the long-term. In fact, data from longitudinal studies has revealed that successful refinement can take several months and that further improvement may be evident even after 1 and 2 year follow-up tests (Carson & Collins, 2015; Carson, Collins, & Jones,

2014). So, despite John's acknowledgement that he needed more time, one or two weeks is probably an unrealistic estimate based on previous studies.

A number of the players revealed that early setbacks dented their *confidence* in their ability to execute the new technique. These players felt that they needed more time to become comfortable with the new movement before they were consistently able to deploy it in competition. It was interesting to note that few of the players' coaches seem to have made an effort to secure the new movement during practice (i.e., pressure-proof it) before it was exposed to the psychological rigors of high-level competition (see Table 3 and Kearney, Carson, & Collins, 2018, for similar accounts from athletics coaches). In contrast to the Five-A model guidelines, it seems that players were introduced to the challenge of competitive pressure, both psychological and physiological, too early before the new skill version had been automatized, pressure-proofed and confidence in the execution regained. Pressure-proofing is an important feature of the Assurance stage since it is designed to enhance an athlete's confidence that the new movement is fully established and that it requires no further modifications. In fact, the participants who successfully refined their technique revealed that their coaches used a variety of strategies (e.g., encouraging a process focus) and certain training drills which enhanced their confidence in the new movement execution.

It may be that for some players in the current study the process (not the technical modification) was insufficiently understood by and/or sold to them. It is interesting to note that players only recognized the need for a progressive, or systematic, approach during their post-process review. Even then, there was a distinct lack of appreciation toward the need to proactively pressure-proof the skill, as one of several absent features of the Five-A Model. Equally, however, it is probable (based on evidence of coaching knowledge in other sports; cf. Carson et al. 2013; Kearney et al. 2018) that coaches did not have, or understand, a systematic approach that would enable success. Planning prior to enacting change appears to

have been uncomprehensive; for example, few players conducted a detailed analysis with their coach whereby the pros and cons of technical refinement, and other alternatives, were evaluated. Indeed, this process needed to include consideration towards the macro-level timing within a competitive season, but no such planning was reported as taking place.

Although the interview process devoted some attention to an exploration of the mechanisms which underpinned coaches' attempts to enact change, this was not its primary focus. Future research could devote more attention to this issue by conducting in-depth explorations of the approaches used by coaches in order to facilitate change (e.g., practice schedules). This enquiry seems particularly relevant given recent findings which suggest that coaches and athletes appear unclear about the most effective way of conducting this process (Carson et al., 2013; Kearney et al., 2018). A systematic approach (e.g., the Five-A model) would seem to be justified at the very least. Future research could interview coaches post-training and include a video debrief to better understand and probe their decision making on-action/in-context as they oversee the technical refinement process. Researchers could also explore whether varying practice conditions influences an athlete's ability to successfully adapt to new task demands (i.e., technical refinement; see Carson, Collins, & Richards, 2016) or conduct a phenomenological investigation of the different trajectories that athletes might take as a result of making refinements/changes (e.g., how setbacks experienced at different stages of the process might influence the athlete's decision to remain committed to the refinement or drop out of the sport).

To conclude, our results suggest the need for improved planning in terms of how tennis coaches might operationalize these psychosocial factors in a systematic manner within the training environment for competition. Ultimately, the results should prove helpful to coaches and psychologists who wish to understand some of the physical and/or psychological difficulties that athletes may face during the technical refinement process. We suggest that

development programmes may need to devote greater consideration towards operationalizing these factors within their specific domain in order to optimize the development and performance of skilled athletes.

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716

717 Table 1. *Overview of the Five-A Model Stages, Purposes and Exemplar References to Support each Stage.*

Stage	**Purpose**	**Supporting References**
Analysis	Provide an individualised diagnosis and prescription to the problem. Consider the pros vs. cons (e.g., to make the change at all? When? How? Refine or regain?). Address the reason for change, including the specific technical aspect. Gain athlete commitment/buy-in.	Armstrong (2001); Magyar & Duda (2000); Martindale & Collins (2005); Prochaska & DiClemente (1992); Theodorakis (1996); Toner et al. (2012); Weston, Greenlees, & Thelwell (2013).
Awareness	Call into consciousness the current technique vs. the desired new technique.	Bar-Eli (1991); Hanin, Malvela, & Hanina (2004); Kostrubiec et al. (2006); Mercado (2008, 2009)
Adjustment	Modify and correct the flaw in technique.	Carson, Collins & Jones (2014); Collins et al. (1999); Hanin et al. (2004); Lang, Kozak, Miller, Levin, & McLean Jr. (1980)
(Re)Automation	Internalise the change to the extent that it is no longer within conscious awareness.	Bortoli, Bertollo, Hanin, & Robazza (2012); MacPherson, Collins & Morriss (2008); Mullen & Hardy (2010); Toner & Moran (2015).
Assurance	Achieve a state whereby the athlete and coach do not require further need for additional modification.	Beaumont, Maynard, & Butt (2015); Carson et al. (2014); Collins et al. (1999); Hanin et al. (2004); Hays, Thomas, Maynard & Bawden (2009); Ross-Stewart & Short (2009); Vealey (2001).

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Table 2: *Participants and Technical Refinements*

Name (Pseudonym)	Age and rating when refinement was made	Technical refinement
Scott	16 (3.1)	Shorten forehand backswing
John	17 (2.1)	Adopting ‘eastern’ grip on forehand
Mike	15 (3.1)	Shorten backhand backswing
Matty	18 (3.1)	Shorten forehand backswing
Paul	18 (1.2)	Moving from an extreme ‘western’ grip towards a more ‘continental’ grip on forehand
Luke	28 (1.1)	Increase shoulder and body rotation throughforehand impact
Michelle	21 (2.2)	Shorten backhand backswing
Andrea	20 (3.1)	“Square” (i.e., neither open or closed in relation to the target) racket face on forehand

Note: For junior and adult players there are 20 rating bands, starting with 10.2, which is the lowest, progressing to 10.1, 9.2, 9.1 etc. until you reach 1.1, which is the highest rating.

733 Table 3. *Summary of the prevalence of perceived antecedents, moderators, and process*

734 *evaluation of technical change*

Lower order themes	Higher order themes	Dimensions
Competitiveness (6)	Continuous improvement	Prechange
Attenuated movement pattern (8)		
Discomfort during Competition (8)	Commitment	
Regulating performance Expectations (6)		
Process versus outcome goals (5)		In-change
Competitiveness (4)		
Belief in coach's ability (7)	Confidence	
Own ability (6)		
Competitive setbacks (6)		
Positive feedback (5)		
Performance proficiency (8)		
Dedicate more time to practicing the new technique (6)		Postchange
Remain patient (5)		
Break from competition (4)		

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Table 4. *A comparison of recommended psychosocial practices by the Five-A Model against those actually reported by participants.*

Psychosocial Factors	Five-A Model Stages				
	Analysis	Awareness	Adjustment	(Re)automation	Assurance
Five-A Model exemplars	Consider the pros vs. cons (e.g., to make the change at all? What? When? How? Why?). Gain buy-in/trust. Establish realistic expectations. Sell the process to important stakeholders.	Continuous personal support via discussion aided by video, goal-setting and monitored through self-reported confidence levels.	Coach and video feedback to enhance confidence, acceptance and commitment. Work on unaffected skills to maintain progress.	Use of imagery scripts and self-set goals to sell progress to the athlete. Practice in context to enhance understanding. Reduced coach involvement to increase athlete independence.	Provide proof that movement is robust in order to maintain and build confidence. Discuss and implement varied game plans in preparation to compete (i.e., tactics/playing style).
Study examples of adherence	Discussing the efficacy of various techniques.	Personal support via coach discussion aided by video.	Use of video to reinforce progression towards the new technique.	Use of practice activities to develop confidence.	No examples evident.
Study examples of inconstancy	Insufficient planning and detailed analysis and athlete input.	Goal-setting against realistic but challenging targets.	Monitoring goals to maintain progress.	Failure to sell progress to the athlete.	No attempt to "pressure-proof" the new movement.

Note: Examples listed do not reflect a systematic application by coaches nor do they reflect the practices reported by every participant.