Tracking relations between development of tactical knowledge and tactical behaviour: a season-long action research study

RAMOS, A <http://orcid.org/0000-0001-9876-3994>, DAVIDS, Keith <http://orcid.org/0000-0003-1398-6123>, COUTINHO, P <http://orcid.org/0000-0002-9182-4448> and MESQUITA, I <http://orcid.org/0000-0001-5985-9686>

Tracking relations between development of tactical knowledge and tactical behaviour: A season-long action research study

Declaration of Interest: none

Abstract

Background: Specific learning experiences are vital for athletes to continuously interact with developing *knowledge of* the performance environment, through the refined design of representative learning contexts (ecological paradigm), and appropriate didactical interventions (constructivist paradigm). Although there is a well-established relationship between tactical knowledge (TK) and tactical behaviours (TB), research has investigated the development of both separately. Thus, the inter-dependency between knowledge and behaviour has been inferred, but not contextually interpreted in a process-oriented analysis of performance.

Purpose: Through an insider action-research (AR) design, and adopting a mix-methods approach, this study aimed to: (i) investigate in-depth the influence of a constructivist-ecological pedagogical intervention on developing players' TK and TB; (ii) explore effects of integrated tactical knowledge and behaviour on competitive performance.

Participants and Settings*:* Fifteen female volleyballers participated in this study. An *insider*-AR (first author assumed the dual role of coach and researcher) was conducted from September 2017 to June 2018. In total, four AR-cycles were completed. A mixed-method approach was used to obtain distinct, but complementary, data on the impact of a constructivist-ecological pedagogical intervention on development of players' TK and TB. Qualitative data were used to explore the development of TK, while TB was analysed through quantitative methods.

Data Collection: Qualitative data on the coach's perceptions were collected using a reflexive diary and field notes, while players' perceptions were recorded through four semi-structured focus-group interviews, one per AR-cycle. Quantitative data from four official competitive matches, one per AR-cycle, were analysed. Players' positional coordinates were used to calculate the synchronisation tendencies of lateral blocking and defensive lines through the cluster-phase method.

Data Analysis: Qualitative data were analysed using thematic analysis, in which inductive procedures deepened understanding of the development of the players' TK. A 4 (matches) x 1 (court direction) repeated-measures ANOVA was used to analyse quantitatively the differences in the mean cluster-amplitude values of lateral blocking and defensive lines between matches. ***Main Findings*****:** The unique integration of constructivist and ecological principles scaffolded the development of players' TK and TB. Players evolved from an initial stage in which they verbally described competitive game scenarios (using *knowledge about* environment), to an endpoint where they revealed superior tactical understanding and action intentionality. Increments in tactical complexity favoured the development of TK and TB in a long-term analysis. However, over the short-term, TB was reduced. The development of players' TK (supported by interactions yielding *knowledge of* practice and performance environments) shaped a basis for the acquisition of co-adaptive TB during competitive performance. ***Practical Implications:*** First, sport practitioners could benefit from combining strategies from different theoretical approaches so that they can satisfy the daily needs of athletes in practice. Second, we advise coaches to adopt didactical and representative learning designs, grounded on video analysis and the co-creation of game-plans. Third, the data imply that *time* and the continuous exposure of players to meaningful and representative practice tasks in learning environments are needed so that athletes can enrich their tactical behaviours, using *knowledge of* the performance environment to interact effectively its constraints.

Keywords: ecological dynamics; constructivism; process-oriented vision; mix-methods; volleyball

Introduction

Competitive demands of team sports require the development of intelligent and self-regulating (tactically autonomous) athletes (O'Sullivan et al. 2021). To achieve this aim, coaches' pedagogical interventions have been gradually moving from a *coach-centred* (i.e., autocratic teaching styles, and reliance on reproduction of highly structured techniques (Lee 1993) to an *athlete-centred* approach, framed with a constructivist paradigm (Kidman & Lombardo, 2010). Constructivism conceives learning as a construction of knowledge built by contrasting previous learning experiences with what is being experienced at a particular moment (Roberts and Potrac 2014). Studies by Gréghaine and colleagues (e.g., Gréhaigne and GodBout 1995) were paramount on conceptualising and systematising the development of tactical knowledge (TK) in invasion team sports games. However, the development of tactical knowledge is dependent on the nature and constraints of each sport (invasion versus non-invasion).

Grounded on a constructivist paradigm, the Step-Game Approach (SGA) is a player-centred approach didactically conceived according to the specific nature of non-invasive team sports, like volleyball (Mesquita et al. 2005). SGA is conceptually based on the Teaching Games for Understanding tenets, with an emphasis on developing TK before the practice of structured techniques (Bunker and Thorpe 1982). Thus, players' abilities are developed by confronting them with step-by-step tactical problems during practice sessions, supporting the formation of meaningful coupling of tactical actions and technical skills (Mesquita et al. 2005). Doing so, sports practitioners act as *learning facilitators* (Godbout and Gréhaigne 2020a). From a didactical viewpoint, the SGA is based on the Skill Development Approach (Rink, French, and Tjeerdsma 1996), which preferences different practice tasks (i.e., acquisition, structuring, adaptation; see supplement 1) according to the players' learning stage. Throughout learning,

variability of practice contexts is gradually increased to accurately resemble game conditions (Pereira et al. 2011).

Nonetheless, players 'construct' their knowledge through continuous player-environment interactions in which understanding (i.e., building a meaning) are continuously (re)developed (Gréhaigne and GodBout 1995). Thus, not only the content, but also the learning environment context is instrumental in athletes applying their previous knowledge. The design of learning environments has also been addressed through the Constraint-led Approach (CLA), based on an ecological dynamics theoretical framework (Araújo, Davids, and Serpa 2005). The CLA is a *player-environment-centred* approach that seeks to understand how players continuously adapt their tactical behaviours (TB) to satisfy interacting task-individual-environmental constraints that emerge during practice and performance (Renshaw et al. 2016). Constraints are defined as boundaries that shape the emergence of movements/behaviours (Newell 1986), providing action opportunities (i.e., affordances) (Gibson 1979) for individuals to *act in* and *interact with* the environment. Accordingly, by manipulating representative constraints, learning environments are designed to address individual performers' needs, with sports practitioners viewed as *environment designers* (Woods, McKeown, Rothwell, et al. 2020).

Although the SGA and CLA derive from highly distinct theoretical paradigms (Renshaw et al., 2015), they share some common theoretical concepts and principles (Pill 2021, Godbout and Gréhaigne 2020b). When practically combined, some key distinctive features and similarities (e.g., ensuring representativeness and contextualised learning or facilitating information-tactics coupling and affordance perception ((Woods, McKeown, Rothwell, et al. 2020, Godbout and Gréhaigne 2020a)) provides a foundation to explore some novel insights on processes of learning, development and performance in sport. Indeed, the design of a learning environment is vital to ongoingly reconstruct knowledge into representative task

designs (CLA). Additionally, an appropriate didactical content of learning (SGA) is needed to develop the TK and TB of athletes.

Decision-making is predicated on TK during performance, and it facilitates the organisation of functional actions and TBs. When players are supported in interacting with the key constraints of well-designed practice tasks, they can learn to self-regulate actions to satisfy constraints during competitive performance (Woods, McKeown, O'Sullivan, et al. 2020, McPherson and Thomas 1989). A key ingredient of athlete self-regulation, from an ecological perspective, is *knowledge of* the environment (Gibson 1966), which supports use of players' TK for directly interacting with the constraints of competition, facilitated by the development of an intertwined relationship between knowledge, perception, and action (Araújo et al. 2019). In turn, *knowledge about* the environment supports verbal description, problem-solving and decision-making via the perception of language, symbols, and verbal instructions (Gibson 1966). The clear implication of Gibson's distinction for sport practitioners is that performance data should be examined, interpreted and then used, in practice, to develop players' *knowledge of* the environment in a process-oriented vision. Intertwined with *knowledge in action* (i.e., TK; (McPherson and Thomas 1989)), TB refers to the functional actions used by athletes to interact with a performance environment (O'Sullivan et al. 2021). Studies exploring TB in team sports typically use notational data and/or players' positional coordinates combined with the application of sophisticated methods (e.g., cluster-phase method) to investigate the internal dynamics of athlete-environment interactions during competition (e.g., team synchronisation tendencies) (Ribeiro et al. 2020).

Although some studies have examined TK and TB in sports (e.g.,Américo et al. 2017, Rico-González et al. 2021), these investigations have mainly adopted a *product-oriented* perspective of tactics (Ramos, Coutinho, Davids, et al. 2021). Focused on outcomes of interventional protocols, such perspective has attempted to explain competitive or training data

through direct and decontextualized relationships. Therefore, there is a lack of understanding on *how* an ongoing pedagogical intervention (i.e., *process-oriented approach*) may impact on an athlete's tactical enhancement. In a process-oriented vision, coaches are challenged to rethink their own pedagogical interventions to adapt and appropriate learning content and environment designs to satisfy each individual athlete's needs. Furthermore, despite a well-established relationship between TK and TB, based on the conception that *knowing* facilitates *perceiving* and *doing* and vice-versa (McPherson 2008), so far studies have tended to investigate the development of both separately. Doing so, the inter-dependence of TK and TB has been inferred, but not contextually interpreted. The use of mix-method approaches could be useful in this respect since, by combining qualitative and quantitative methods, it is possible to better understand the investigation problem than by using either methodology alone (Creswell 2014). To date, there have been very few mix-methods studies seeking to explore the relationship between TK and TB.

Given its interventionist nature, Action-Research (AR) designs (Lewin 1946) may be most valuable for examining the combination of constructivist-ecological approaches in a process-oriented vision throughout extended competitive periods. Through an *insider*-AR, conducted over a competitive season, this study adopts a mix-methods approach to: (i) investigate in-depth the influence of an SGA-CLA pedagogical intervention on developing athletes' TK and TB (expressed as synchronisation tendencies), and (ii), to explore the relationship between TK an TB in competition. It was expected that, across the season, athletes would develop their TK and TB as a function of experiencing representative and meaningful learning tasks. Also, it is hypothesized that the development of TK could be a precursor of more synchronised TBs in competition.

Methods

Study Design

An *insider*-AR design was undertaken over the season (i.e., first author assuming the dual-role of coach-researcher). Given its reflexive and interventionist nature (Coghland 2019), this design afforded the opportunity to monitor, evaluate and contextually adapt the coaching intervention according to the players' and team's tactical needs. From September 2017 to June 2018, four AR-cycles were conducted, each one including processes of planning, acting and monitoring, and reflection/analysis (Lewin 1946). As recommended by Gilbourne (1999), the first AR-cycle involved environment exploration by players, and the coach's diagnosis about the main individual and collective tactical problems that needed to be addressed in subsequent AR-cycles. The CLA and SGA principles were integrated to support the development of players' TK and TB (please, see supplement 2 and 3 for a better understanding). Reflections and unresolved tactical issues identified at the end of each AR-cycle guided subsequent pedagogical interventions.

Within the AR-design, a mixed-method approach was used to obtain distinct, but complementary, data on: (i) the impact of an ecological-constructivist pedagogical intervention on players' TK and TB, and (ii), the relationship between TK and TB development (Creswell 2014). Using multiple data sources, data analysis techniques, and through triangulation of outcomes, we sought to expand understanding and integrity of our findings. Qualitative data were used to explore TK development, while TB was analysed through quantitative procedures. Both data sets were mixed through *"merging the data"* for bringing them together (Creswell 2007). Figure 1 represents the timeline of qualitative and quantitative procedures for each AR-cycle.

Figure 1

Context and Participants

A youth team of a prestigious Portuguese volleyball club, which over the last 10 years competed in the highest-level female and male national leagues, participated in this study. Club's philosophy follows a long-term vision of sports development, with the youth players being gradually integrated into senior and national teams. Purposive and convenience sampling criteria (Sarstedt et al. 2018) were used to select the fifteen female players, aged between 14 and 15 years. All players had experience of at least one year of formally organised training and practice. They were considered "information-rich" due to being at the beginning of their sporting pathway, so they did not contain preconceptions on volleyball practice and were actively engaged in participation. The first author performed the dual role of coach-researcher. As a researcher, she had already completed a Doctoral degree in sport sciences. As a coach she holds the highest coaching certification (level-III), accumulating 10-years of experience, during which the team won two National Championships, one Super Cup and one Portuguese Cup.

The Declaration of Helsinki guidelines were followed and approved by the first author's Institutional Research Ethics Committee. Players and their parents/legal tutors were informed about the study's scope and the possibility to withdraw from it at any time. Informed consent forms were signed by both. Confidentiality was ensured using pseudonyms.

Coaching Pedagogical Intervention

Pedagogical methods, based on an integration of key ideas from ecological (CLA) and constructivist (SGA) paradigms were utilised by the coach over the competitive season (see supplement 2 and 3). According to SGA, training sessions encompassed tactical and didactical specificities of volleyball games through three types of instructional tasks: acquisition, structuring and adaptation (Mesquita et al. 2005). Concomitantly, CLA principles were included in the design of learning environments (e.g., through manipulation of representative task constraints;Woods, McKeown, Rothwell, et al. 2020). The main instructional principles

considered in each approach are presented in supplement 1, while examples of the pedagogical intervention conducted are described in supplement 2. During the season 143 training sessions and 32 official matches were undertaken. On average, players undertook 4 training sessions (2-hours each) and competed in one official match per week.

The CLA-SGA applications were validated by one external observer, with relevant expertise (i.e., doctorate in sports sciences, major in sports pedagogy and coaching) in both approaches, and one co-author. Both observers analysed the documented training plans and training video records. A checklist of ten-items adapted from previous research by Ramos et al. (2021) was used to confirm the coaching intervention fidelity (see supplement 3). Eighteen training sessions – > 10% of the total sample – were arbitrarily examined by the external observer and co-author, in an independent fashion (Tabachnick and Fidell 2007). The 100% agreement level between observers about the application of the integrated CLA-SGA approach by the coach-researcher validated the suitability of the methodological combination.

Data Collection

Qualitative data: Data on the coach's perceptions were collected through a Reflexive Diary and Field Notes, while players' insights were recorded using semi-structured Focus-Group (FG) interviews. A total of 39 reflections were recorded enabling to access to the coach's critical and emotional perspectives and offering information about her own contextual understanding and professional judgement (Thomas, Morgan, and Mesquita 2013). A reflexive diary provided opportunities to: (i) reflect on the impact of her pedagogical intervention on players' tactical development, (ii) didactically inform the training process ongoingly, and (iii), formulate valuable questions for FG interviews. Field notes guided the writing of the coach's reflections, referring to the most relevant and personal perceptions experienced in training and competition. Four FG interviews, one per AR-cycle, were conducted with players, with each

one lasting around 60 minutes. The team was divided into two groups of eight and seven players. All interviews were audio-recorded and transcribed verbatim by the first author. The FG triggered a debate between players, affording coherent reflections about their own tactical development, and thereby increasing data quality (Sparkes and Smith 2014).

Quantitative data: Four official matches, one per AR-cycle, were selected for analysis. Supplement 4 describes their inclusion criteria. All matches were performed on a volleyball court of 18 x 9 m (width x length) and filmed using a digital camera with a zooming rate fixed to streamline motion image treating. Images were captured at a frequency of 25 Hz and a resolution of 1920 x 1080 pixels. Players' positional coordinates when blocking (i.e., zone 2, 3 and 4) and defending (i.e., zone 1, 6 and 5) were recorded through TACTO software (version 8.0), with an accuracy level superior to 95% at 25 Hz (Fernandes et al. 2010). Six calibration points were applied, namely on the ends of the court (two points), on the lateral 3 m line (two points), and over antennas (two points). The players' working point was tracked using a computer mouse in a slow-motion video, enabling us to collect 2D virtual coordinates (expressed in pixels). Direct Linear Transformation method was applied to convert virtual to real coordinates (expressed in metres) (Duarte et al. 2010). Next, players' real-world coordinates were used to calculate the synchronisation tendencies of lateral blocking and defensive lines through the Cluster-phase method (Richardson et al. 2012). Lateral synchronisation tendencies refer to the tactical coordination patterns formed by blockers and defenders' interactions over time, informing about their collaborative TBs. Only the data in the lateral court direction were analysed because the game dynamics in the counterattacking-phase are more prominent in this axis (Ramos, Coutinho, Ribeiro, et al. 2021). The expressions reported by Ramos and colleagues (2021) were used to compute the cluster-amplitude values in each time-series. The cluster-amplitude varies from 0 (completely unsynchronised) to 1 (totally synchronised). All routines were implemented in GNUOCTAVE (version 5.1.0).

Methodological Rigour

Qualitative data: To deal with subjectivity issues inherent to an insider-AR, to ensure data trustworthiness and to facilitate affinity with participants, the coach-researcher listened to and recorded the players' opinions and insights. In doing so, the coach showed care and impartiality, expressing in words and acts the genuine intentions to enrich the learning experiences of the players (Coghland 2019). Three additional trustworthiness procedures were used: (i) data triangulation among distinct sources, with the coach's interpretations, players' perceptions and team events being continuously validated through additional data generated at each AR-cycle (Denzin 2012), (ii) players' inquiry about the real meaning of their verbal interventions, enabling them to add, redefine or delete information that did not represent what they intended to communicate (Patton 2015), and (iii), peer-debriefings between the first author and co-authors (who are volleyball coaches and/or highly knowledgeable in sport pedagogy). By acting as "critical friends", helping to interpret the data, and affording alternative findings explanations, they minimized the risk of individual researcher bias (Lincoln and Guba 2005).

Quantitative data: Eight playing sequences (two per match) were randomly selected, and players' movement trajectories were re-digitised by the same operator. Data accuracy and reliability were tested using, respectively, the percentage of technical error of measurement (%TEM) and reliability coefficient (R) (Goto and Mascie-Taylor 2007). The intra-observer results demonstrated good accuracy and reliability levels (%TEM = 0.48; R = 0.99).

Data Analysis

Qualitative data: Thematic Analysis was used to examine qualitative data, enabling researchers to identify, analyse and report themes within huge data sets (Braun and Clarke 2012). As recommended by Braun and Clarke (2019), initially the data from the reflexive diary

and FG interviews were extensively read to ensure an appropriate familiarization. Next, inductive line-by-line open coding was undertaken to search for main categories and retrieve critical thoughts and ideas. The third stage encompassed analysis of codes and their possible combination to form coherent themes and subthemes according to the chronological perspective of the data. The last level of analysis involved working back and forth to name the most representative themes. Frameworks on coaching pedagogies, players' tactical development (Mesquita et al. 2005) and design of ecological learning tasks (Woods, McKeown, Rothwell, et al. 2020) were ideas used to examine data in a deeply contextualised and sensitive fashion. The data were not forced to fit theory, rather new insights were sought that could corroborate or contradict the current theoretical perspectives.

Quantitative data: A 4 (matches) x 1 (court direction) repeated-measures ANOVA was used to analyse the differences in the cluster-amplitude mean values of lateral blocking and defensive lines among four matches. Given the identical sample sizes of groups, the homogeneity of variances was assumed (Field 2009). Violations of sphericity assumption for the within-participant variable were assessed through Mauchly's test, and the Greenhouse-Geisser correction procedure was used to adjust the degrees of freedom of the ANOVA 'F term' when needed. Pairwise differences were evaluated through Bonferroni post-hoc. The statistical significance level was set at $p = 0.05$. Effect size values were interpreted by partial eta-squared (η_p^2) (Levine and Hullett 2002), as small ($\eta_p^2 < 0.06$), moderate ($0.06 \leq \eta_p^2 < 0.15$) or large ($\eta_p^2 \geq 0.15$) (Cohen 1988). Inferential statistical procedures were conducted using SPSS 27.0 software (IBM, Inc., Chicago, IL).

Results

Considering the hypothesis that TK (framed as *knowledge of* the performance environment) could be closely aligned with emergent and functional TBs in competition, we start by presenting qualitative results first.

Qualitative Findings

1st AR-cycle – How did we start?

Initially, players learned to describe the *knowledge about* the rival team's tactical game patterns, using their declarative knowledge (describing "what is happening"). However, players were still learning to autonomously comprehend and directly interact with the competitive constraints of performance to adapt their tactical patterns (using *knowledge of* the environment). Although players were able to verbally identify some key competitive constraints, like match-status, these tended to be viewed as inhibitors of performance rather than as opportunities for action in competition, as the following interview excerpts note:

"Researcher (R): When you are serving, what do you think?
Mariah: I only think about what you said to me. If you said, 'serve on diagonal', I will only focus on do it.
Elizabeth: For me, it depends on the match score, if the score is 24/23, I cannot fail.
R: Do you feel that your setting options changed since 20 points?
Kate: I cannot vary the game, I only set to the player who I know is going to score more."

1st FG, 23 November

To reverse this trend, the coach was always concerned with explaining in detail the purpose and goals of each learning task, as well as to clearly contextualise them with possible competitive performance scenarios. Task constraints manipulation, like the match score, were used to scaffold this process:

"For all learning tasks I clearly stated: 'we are going to practice this because our next rivals play like that, so this is one of the best ways for us to score'. Indeed, I felt that players' performance improved when they understood the purpose of the task."

5th DR, 16 October

"We were playing a conditional game-form that started at 13/13 [i.e., play was initiated by the coach attacking or tossing a ball], *but from 20/20 (decisional set moment) the game was formal* [i.e., the team that scored, serve]. *I did it to stimulate the players' focus on their decision-making, and it was unbelievable how our game-pattern changed during this game moment, mostly in reason of the huge number of unforced errors. […] I thought that I must conduct this type of learning tasks more frequently, since it revealed itself as a good tool to let players think about the impact of their tactical decisions."*

10th DR, 13 November

2nd AR-cycle – How can we start developing TK?

To stimulate development of players' *knowledge of* the environment and enhance their ability to perceive critical information sources to regulate their actions, the coach started to discuss game-plans with them, particularly when, how and why they could occupy space on court during a counterattack.

"When I was remembering the game-plan and the block priorities, which were only zone 4 and 2, Kate shared a brilliant observation: 'coach, in that case, the middle-blockers can start a little bit more away from the net so that they can move quickly to one side or another."

15th DR, 16 December

Additionally, the coach increased the complexity of tactical game modelling in practice designs, by introducing a double-block organization. As the next excerpt highlights, these increments in game complexity were essential for players to enrich their ability during practice to become perceptually attuned to the most critical affordances of competition, instead of simply performing pre-planned and decontextualized techniques.

R: You said that you are currently understanding the game better. Is there any connection with the increase in game complexity?
Katherine: Yes, once the game became more complex, we need to stay focused, think more and this ends up affecting us […] for instance, during the defense, now I can see the block, if the blocker's hand is covering the inside or outside of the ball… I know that I must compensate. At the beginning, I only did what the coach told me to do, without thinking about it.

2nd FG, 20 January

At this point, players began to better understand the influence of designing representative learning tasks, intentionally constrained and adjusted according to their needs. Notably, as later shown by the participant Lilian, players were able to recall and recognize similarities between learning tasks performed during training sessions and competitive demands. They advocated that this coaching intervention provided them with a feeling of security:

"R: What did you think that helped you to develop your game understanding?

Lilian: The coach planned a lot of specific tasks and through them we can develop our mind.
Penny: The best players always attack the same zones, and we practise this type of defense.
Liz: Yes! And the block! There are also several blocking tasks based on the features of our next opponent.
R: And why are these types of tasks important?
Lilian: Because it is what could happen in the game, and even if does not happen at least we are prepared […] for instance, when the ball comes to us, we do not remember 'I'll do it like I did during the training', but after some rallies we thought 'yeah, I practised it over the week'.
Rita: Yes, and we feel more confident."

2nd FG, 20 January

3rd AR-cycle – The coach as a facilitator and designer of TK

At this stage, the operationalization of ecological and constructivists strategies was more prominent. The constructive, and gradually more sophisticated, building of the game-plan (enhancing *knowledge about* the environment) was acknowledged as vital by the coach and players. Indeed, while the coach felt the progressive refinement of players' tactical analyses and ability to interpret and anticipate action opportunities, the players highlighted its importance in developing TK:

"I noticed that the quality and detail of game-plans that they share with me, and between each other, have largely improved week after week. Particularly from a tactical viewpoint, we have been successful mainly in regard to the block and defense."

29th DR, 18th March

"R: Do you think that the game-plan has contributed to develop your game understanding?
Rose: Yes, because we understand what could happen. For instance, we will attack according to how they organize the defensive system, but we know that if they change their system, we will change our attack too.
Katherine: I think the game-plan also helped us to adapt because all game-plans are different."

3rd FG, 4th April

Interestingly, as the next excerpt illustrates, the appropriate application of augmented strategical thinking was used within challenging competitive environments:

"That moment [final set moment] *when Liz came running to me and said: the number 15 is playing as middle-blocker now, I will call 'short' with Agatha* [meaning that Agatha will attack in zone 3, thereby fixing the opponent middle-blocker] *so that Mariah can attack with a 1x1 situation ok?! It was an amazing moment for me, as coach."*

33rd DR, 15th April

Still, at this phase, players were able to verbally describe and explain how the main principles established for each game-plan were operationalized in learning tasks. Particularly by constraining game-forms according to a tactical problem addressed at the beginning of each training session, the players increased their sensitivity to *meaningful* practice. The next excerpts clarify this process:

"R: What do you think about the learning task designed for each training session?
Loren: We do it according to the game-plan.
Liz: But we also practice what we need, as a team.
Rose: For instance, the coach tied the band over the antennas, and I get it why… the block of your next rival is very tall, so if we decide to perform a roll-shot we need to do it above the band.
Katherine: At the final part of the training, when we play conditioned games, we can use what we had practiced before. For instance, when we practiced all the blocking line, during the match we can practice it… we train with a purpose."

3rd FG, 4th April

4th AR-cycle – Reaching out an adaptable TK

At the end of the season, players were able to retrieve and interpret, during competitive performance, most of the critical information needed to support their interactions – acquiring *knowledge of* the performance environment. Hence, as the next excerpt portrays, players were also able to anticipate and appropriately use meaningful actions opportunities.

"They were playing by their own. It was unbelievable to feel how they now communicate, how they were able to anticipate opponents' actions, and how they are actually more effective in executing collectively all the game actions."

39th DR, 25th May

Moreover, players also started to display multifactorial strategical thinking. As described by the setters Kate and Emily, their decision-making entailed considering several variables, and not exclusively the match-status, as mentioned earlier. The next excerpt corroborates this tactical growth:

"R: Kate and Emily, regarding setting actions, what constrains your setting options?
Kate: The rival's blocking line, I mean who is blocking.
Emily: Who is attacking in our team, and the game moments.
Kate: And the quality of our passing as well."

4th FG, 2nd June

Last, players were able to fully comprehend the didactical logic behind the ecological design of a whole training session. Furthermore, as stated by Emily, the pedagogical process framed by the coach's support also seems to play an important role in developing players' strategical thinking, as the next excerpt addresses:

"R: and in your opinion, why are these types of matches important?
Elizabeth: Because it is a replica of what it could happen during the official match.
R: So, did you think that the conditional game-forms helped you?
Emily: Yes […] sometimes I set to the best attacker, but the coach told me she is attacking against the best blocker and let me think about it. The coach also helped me."

4th FG, 2nd June

Quantitative Findings

Figure 2 summarises the descriptive statistics of the lateral cluster-amplitude values regarding blocking and defensive lines from match 1 to 4, and Table 1 displays the statistical differences that emerged between the subsequent AR-cycles. To align the quantitative and qualitative data, Table 2 only presents the contrast between M1-M2, M2-M3, M3-M4, and M1-M4 to broadly inform about the change that occurred in collective TB from the beginning through to the end of the season. The inter-match analysis revealed moderate significant differences in lateral synchronisation tendencies of the blocking line, and large significant differences in the defensive line.

Figure 2 and Table 1

Discussion

Through an *insider*-AR intervention lasting for a whole volleyball season, a mix-methods approach was used to: (i) explore in-depth the impact of a constructivist-ecological approach on developing players' TK and TB, and (ii) examine the relationship between TK and TB in competition. Results showed how the integration of SGA-CLA principles scaffolded the

development of TK and TB. Overall, players evolved from an initial stage in which they were able to verbally interpret and describe competitive game scenarios to an endpoint where they showed superior tactical understanding, deeply integrated into their actions' intentionality during competitive performance. Increments in tactical complexity favoured the development of players' TK and TB in a long-term analysis. However, over a short-term period, TB became less sophisticated. Also, the development of players' TK shaped a basis for the acquisition of co-adaptative TB in competition. The insider-AR enabled the coach to tailor the pedagogical intervention to the learning and performance issues raised by players. Furthermore, the mix-methods approach afforded us to comprehend in-depth how the pedagogical process was adapted, and why (i.e., process-oriented vision), with such an intervention being made more robust by the objectivity offered by the quantitative analysis.

Throughout the 1st AR-cycle the coach-researcher identified individual and collective tactical weaknesses. Although players applied their *knowledge about* the environment, identifying some opponents' tactical game patterns, they showed some difficulties in using their *knowledge of* the environment to overcome such tactical trends. Players displayed a poor tactical understanding about the purpose of learning tasks, and their similarities with competitive demands. Additionally, players showed limitations in their ability to interpret, by themselves, the most critical competitive constraints and/or action opportunities (affordances). This weakness necessitated the guided discovery methods favoured by the coach in adopting an ecological-constructivist framework. This was recognised in Kate's response (1st FG) on contrasting match-status with opposition blockers and/or setting options. Hence, the use of tactics in competition by players was naive and mostly linked to the coach's feedback before they learned how to self-regulate in performance. In this phase the team displayed high synchronisation tendencies in blocking and defensive lines. This apparent mismatch between qualitative (TK) and quantitative (TB) data could be explained by the simplistic game-

modelling initially adopted (i.e., single-blocker and five defenders occupying the remaining court). Therefore, the TBs expressed were directly supported by the coach instead of being functionally self-regulated by players. These findings corroborate conclusions reported in previous investigations of Ramos et al. (2020) and Ramos, Coutinho, Ribeiro, et al. (2021).

To provide players with different and more challenging stimuli and encourage problem-solving and tactical intentionality, throughout the 2nd and 3rd AR-cycles, the coach favoured guided discovery methods to clarify the purpose of learning tasks, and their clear association with competitive demands. Pedagogical strategies from SGA-CLA were combined to align learning contexts with players' needs (Mesquita et al. 2005, Woods, McKeown, Rothwell, et al. 2020). These strategies included the co-construction of game plans between coach and players (i.e., democratic style and player-centred approach), the use of implicit feedback (i.e., avoiding direct prescription and using open-ended questioning), as well as the increasing sophistication of game-modelling complexity (i.e., scaffolding the transition between learning stages through manipulation of representative learning task constraints) (Pill 2021). Gradually, these pedagogical strategies were refined during the 3rdAR-cycle, with the coach adopting, in an integrated fashion, the role of *learning facilitator* and *environment designer* (please see supplement 2 for practical details;Godbout and Gréhaigne 2020a, Godbout and Gréhaigne 2020b).

The combined SGA-CLA strategies had distinct repercussions on players' TK and TB in a short-term analysis. Players largely acknowledged the importance of combining CLA-SGA strategies to develop their game-related knowledge, specifically the ability to interpret competitive constraints and engage in a flow of sharing action opportunities (exemplified by the question of Liz during the competition - 3rdAR-cycle). Contrary to the progressive evolution of players' TK, the collective synchronisation tendencies (TB) of participants were significantly impacted as tactical complexity increased (match 3). First, this finding evidenced that the self-

organisation tendencies of a team can be shaped by the introduction of "noise" (in this case, greater complexity in tactical game-modelling) (Gréhaigne and Godbout 2014). Second, it suggests that there was a delay between development of the players' TK (i.e., *knowledge of* the environment) and its observations in practical application during interactions with competitive contexts (Araújo et al. 2019).

In the 4thAR-cycle, a substantial enhancement in players' TK was noted. Players displayed more collaborative skills that allowed them to effectively self-organize and anticipate opponents' moves. Linking this result with quantitative evidence revealed that, in practical terms, enhancements in players' TK were expressed by the (re)achievement of high levels of lateral synchronisation tendencies at the blocking and defensive lines. In fact, even performing within a more complex tactical game-modelling, recorded values of synchronisation tendencies in the team were greater than those observed initially. This finding has two major implications.

First, it underlines the need for a continuous exposure to representative practices so that gains in understanding (developing meaningful, game-related knowledge) can be translated into practice as functional TB (i.e., higher synchronisation tendencies) (McPherson 2008). Indeed, the sharing of affordances that support synchronisation tendencies, implies a preliminary and common perception of competitive constraints and affordances (Godbout and Gréhaigne 2020b). Combining SGA-CLA principles and strategies, the coach-researcher ensured the design and monitoring of didactical and representative learning environments that promote such collective attunement to relevant information for action. Second, it suggests that TK forms a useful foundation to perform intended game-actions, supported by relevant TBs in competition. In fact, implementation of tactics in competition requires the ability to identify and interpret the tactical scenarios within which players are embedded. Thus, by recognising the importance of the active and individual construction of knowledge (constructivist paradigm) and the dynamic and interactive player-environment relationship (ecological paradigm), the combined use of

SGA-CLA was revealed as pertinent and useful to develop players' learning and performance in a process-oriented vision.

Practical Applications and Final Thoughts

This study offers relevant evidence for sport practitioners (researchers, coaches, performance analysists, etc.). First, the combination of traditionally opposed, yet complementary, approaches (SGA-CLA) enabled to better respond of the multifactorial and dynamics demands of sport praxis. Therefore, coaches should be capable of combining principles and strategies so that they can satisfy appropriately the needs of individual players. Second, coaches may adopt didactical and representative learning designs grounded on video analysis and the co-building of game-plans since this procedure was highlighted by players as vital in linking practice session design with competitive demands. Third, as TK was revealed as a precursor for developing TB, we encourage coaches to focus on enhancing the game-related *knowledge of* the performance environment in youth players (process-oriented vision), instead of being merely concerned about winning/losing matches (product-oriented vision). However, as the relationship between TK and TB differed over a short timescale, a final consideration is that *time* and continuous exposure to varied, meaningful and representative pedagogical interventions are needed so that players can use their ability to identify and interpret critical information to underpin effective TB. Finally, the insider AR, integrated with a mix-methods approach, was appropriate for the coach's pedagogical intervention for reaching out to every player. Accordingly, the potentialities of this sophisticated research design should be explored in future investigations, in other competitive performance or school contexts.

Word count: 7209

Disclosure statement

No potential conflict of interest was reported by the author(s).

References

Américo, Bueno, Marizabel Kowalski, Felippe Cardoso, Caito André Kunrath, Sixto GonzáLez-Víliora, and Israel Teoldo. 2017. "Difference in declarative tactical knowledge between u-11 and u-15 soccer players." *Human Movement* 18 (5):25-30.

Araújo, Duarte, K. Davids, and S. Serpa. 2005. "An ecological approach to expertise effects in decision-making in a simulated sailing regata." *Psychology of Sport and Exercise* 6 (6):671-692.

Araújo, Duarte, Robert Hristovski, Ludovic Seifert, João Carvalho, and Keith Davids. 2019. "Ecological cognition: expert decision-making behaviour in sport." *International Review of Sport and Exercise Psychology* 12 (1):1-25. doi: 10.1080/1750984X.2017.1349826.

Braun, Virginia, and Victoria Clarke. 2012. "Thematic Analysis." In *Handbook of Research Methods in Psychology*, edited by H. Cooper, P. M. Camic, D. L. Long, A. T. Panter, D. Rindskopf and K. J. Sher, 57-71. Washington, DC: American Psychological Association.

Braun, Virginia, and Victoria Clarke. 2019. "Reflecting on reflexive thematic analysis." *Qualitative Research in Sport, Exercise and Health* 11 (4):589-597. doi: 10.1080/2159676X.2019.1628806.

Bunker, D, and R. Thorpe. 1982. "A model for the teaching games in secondary schools." *Bulletin of Physical Education* 18 (1):5-8.

Coghland, David. 2019. *Doing an action research in your own organization*. 5th ed. London: SAGE.

Cohen, Jacob. 1988. *Statistical power analysis for the behavioral sciences*. 2nd ed. Hillsdale: Lawrence Erlbaum Associates.

Creswell, J. W. 2007. "Understanding mixed methods research." In *Designing and conducting mixed methods research*, edited by J. W. Creswell & V. L. P. Clark. London: Sage Publications.

Creswell, J. W. (2014). 2014. *Research design: Qualitative, quantitative and mixed methods approaches*. London: SAGE.

Denzin, Norman K. 2012. "Triangulation." *Journal of Mixed Methods Research* 6 (2):80-88. doi: 10.1177/1558689812437186.

Duarte, Ricardo, Duarte Araújo, Orlando Fernandes, Cristina Fonseca, Vanda Correia, Vítor Gazimba, Bruno Travassos, Pedro Esteves, Luís Vilar, and José Lopes. 2010. "Capturing complex human behaviors in representative sports contexts with a single camera." *Medicina* 46 (6):408-414.

Fernandes, Orlando, Hugo Folgado, Ricardo Duarte, and P. Malta. 2010. "Validation of the tool for applied and contextual time-series observation." *International Journal of Sport Psychology* 41:63-64.

Field, Andy. 2009. *Discovering statistics using SPSS*. 3rd ed. London: Sage publications.

Gibson, J.J. 1979. *The Ecological Approach to Visual Perception*. Boston: Houghton Miffin.

Gibson, James. 1966. *The senses considered as perceptual systems*. 1st ed. Boston: Houghton Mifflin.

Gilbourne, D. 1999. *Collaboration and reflection: Adopting action research themes and processes to promote adherence to changing practice*. Edited by S. Bull., *Adherence Issues in Sport and*

Exercise. Chichester, England: John Wiley & Sons Ltd.

Godbout, Paul, and Jean-Francis Gréhaigne. 2020a. "Regulation of tactical learning in team sports – the case of the tactical-decision learning model." *Physical Education and Sport Pedagogy*. doi: 10.1080/17408989.2020.1861232.
Godbout, Paul, and Jean-Françis Gréhaigne. 2020b. "Revisiting the Tactical-Decision Learning Model." *Quest* 72 (4):430-447. doi: 10.1080/00336297.2020.1792953.
Goto, Rie, and Nicholas Mascie-Taylor. 2007. "Precision of Measurement as a Component of Human Variation." *Journal of Physiological Anthropology* 26 (2):253-256. doi: 10.2114/jpa2.26.253.
Gréhaigne, J. F., and P. Godbout. 2014. "Dynamic Systems Theory and Team Sport Coaching." *Quest* 66 (1):96-116. doi: 10.1080/00336297.2013.814577.
Gréhaigne, Jean-Franis, and Paul GodBout. 1995. "Tactical knowledge in team sports from a construtivist and cognitivist perspective." *Quest* 45:490-505.
Kidman, L., & Lombardo, B. J. (2010). Being Athlete-centred: the Humanistic Coach. In L. Kidman & B. J. Lombardo (Eds.), *Athlete-centred Coaching: Developing decision makers* (2nd ed.). Worcester, UK: Innovative Prin Communications.
Lee, C 1993. "Operant strategies in sport and exercise: Possibilities for theoretical development." *International Journal of Sport Psychology* 24:306-325.
Levine, T, and C Hullett. 2002. "Eta square, partial eta square, and misreporting of effect size in communication research." *Human Communication Research* 28:612-625.
Lewin, K. 1946. "Action research and minority problems." *Journal of Social Issues* 2 (4):34–46.
Lincoln, Y.S., and E.G. Guba. 2005. "Paradigmatic controversies, contradictions, and emerging influences." In *Handbook of Qualitative Research* edited by N.K. Denzin and Y.S. Lincoln, 191-216. Thousand Oaks, CA: SAGE Publications.
McPherson, S. 2008. "Tatics - Using knowledge to enhance sport performance." In *Developing sport expertise*, edited by D Farrow, J Baker and C MacMahon, 155-171. London: Routledge.
McPherson, S., and J. Thomas. 1989. "Relation of knowledge and performance in boys' tennis: age and expertise." *Journal of Experimental Child Psychology* 48 (2):190-211.
Mesquita, Isabel, A Graça, A Gomes, and C Cruz. 2005. "Examining the impact of Step Game Approach to teaching volleyball on student tactical decision-making and skill execution during game play." *Journal of Human Movement Studies* 48 (6):469-492.
Newell, K. M. 1986. "Motor development in children: Aspects of coordination and control." In *Constraints on the development of co-ordination*, edited by M. G. Wade & H. T. A. Whiting, 341-360.
O'Sullivan, M, C Woods, J Vaughan, and K Davids. 2021. "Towards a contemporary player learning in development framework for sports practitioners." *International Journal of Sports Science & Coaching*. doi: 10.1177/17479541211002335.
Patton, M. Q. 2015. *Qualitative research and evaluation methods*. Thousand Oaks, CA: Sage.
Pereira, F. R. M., A. B. D. S. Graça, M. Blomqvist, and I. M. R. Mesquita. 2011. "Instructional approaches in youth volleyball training settings: The influence of player's age and gender." *International Journal of Sport Psychology* 42 (3):227-244.
Pill, Shane. 2021. "Reconciling approaches: Informing game sense pedagogy with a constraints-led perspective." In *Game Sense for Teaching and Coaching*, edited by Richard L. Light and Christina Curry. New York: Routledge.
Ramos, Ana, Patrícia Coutinho, Keith Davids, and Isabel Mesquita. 2020. "Developing players' tactical knowledge using combined Constraints-led and Step-Game Approaches – A longitudinal action-research study." *Research Quarterly for Exercise and Sport* 94 (4):584-598. doi: 10.1080/02701367.2020.1755007.

Ramos, Ana, Patrícia Coutinho, Keith Davids, and Isabel Mesquita. 2021. "How could process-oriented research approaches capture the interplay between training and competition in athlete performance preparation? The contribution of ecological dynamics." *Psychology of Sport & Exercise* 57 (102019):1-6. doi: 10.1016/j.psychsport.2021.102019.

Ramos, Ana, Patrícia Coutinho, João Ribeiro, Orlando Fernandes, Keith Davids, and Isabel Mesquita. 2021. "How can team synchronisation tendencies be developed combining Constraint-led and Step-Game approaches? An action-research study implemented over a competitive volleyball season." *European Journal of Sport Science*. doi: 10.1080/17461391.2020.1867649.

Renshaw, Ian, Duarte Araújo, Chris Button, Jia Yi Chow, Keith Davids, and Brendan Moy. 2016. "Why the Constraints Led Approach is not Teaching Games for Understanding a clarification." *Physical Education and Sport Pedagogy* 21 (5):459-480.

Ribeiro, João, Rui Lopes, Pedro Silva, Duarte Araújo, Daniel Barreira, Keith Davids, João Ramos, José Maia, and Júlio Garganta. 2020. "A multilevel hypernetworks approach to capture meso-level synchronisation processes in football." *Journal of Sports Science* 38 (5):494-502. doi: 10.1080/02640414.2019.1707399.

Richardson, Michael J., Randi L. Garcia, Till D. Frank, Madison Gergor, and Kerry L Marsh. 2012. "Measuring group synchrony: a cluster-phase method for analyzing multivariate movement time-series." *Frontiers in Psychology* 3 (405):1-10. doi: 10.3389/fphys.2012.00405.

Rico-González, Markel, José Pino-Ortega, Filipe Manuel Clemente, Daniel Rojas-Valverde, and Asier Los Arcos. 2021. "A systematic review of collective tactical behaviour in futsal using positional data." *Biology of Sport* 38 (1):23-36. doi: 10.5114/biolsport.2020.96321.

Rink, J., K. French, and B. Tjeerdsma. 1996. "Foundations for the learning and instruction of sport and games." *Journal of Teaching in Physical Education* 15 (4):399-417.

Roberts, Simon, and Paul Potrac. 2014. "Behaviourism, Constructivism and Sports Coaching Pedagogy: A Conversational Narrative in the Facilitation of Player Learning." *International Sport Coaching Journal* 1:180-187.

Sarstedt, Marko, Paul Bengart, Abdel Monim Shaltoni, and Sebastian Lehmann. 2018. "The use of sampling methods in advertising research: a gap between theory and practice." *International Journal of Advertising* 37 (4):650-663.

Sparkes, A. C, and B Smith. 2014. *Qualitative research methods in sport, exercise and health: From process to product*: Abingdon: Routledge.

Tabachnick, B. G., and L. S. Fidell. 2007. *Using Multivariate Statistics*. 5th ed. New York: Allyn and Bacon.

Thomas, Gethin, Kevin Morgan, and Isabel Mesquita. 2013. "Examining the implementation of a Teaching Games for Understanding approah in junior rugby using a reflective practice design." *Sports Coaching Review* 2 (1):49-60.

Woods, Carl T., Ian McKeown, Mark O'Sullivan, Sam Robertson, and Keith Davids. 2020. "Theory to Practice: Performance Preparation Models in Contemporary High Level Sport Guided by an Ecological Dynamics Framework." *Sports Medicine* 6 (36):1-11. doi: 10.1186/s40798-020-00268-5.

Woods, Carl T., Ian McKeown, Martyn Rothwell, Duarte Araújo, Sam Robertson, and Keith Davids. 2020. "Sport Practitioners as Sport Ecology Designers: How Ecological Dynamics Has Progressively Changed Perceptions of Skill "Acquisition" in the Sporting Habitat." *Frontiers in Psychology* 11 (654):1-15. doi: 10.3389/fpsyg.2020.00654.

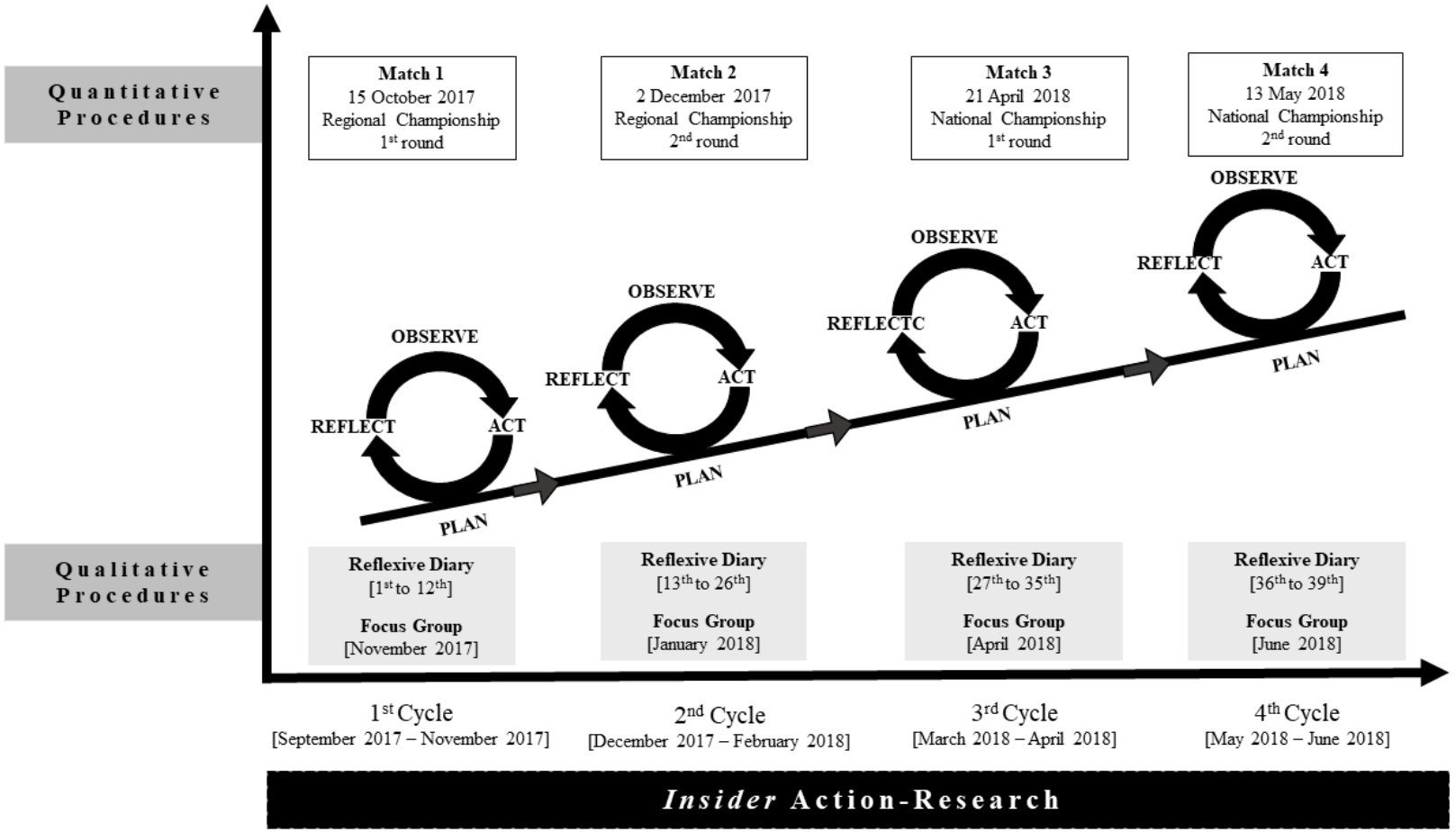

Figure 1. Timeline of qualitative and quantitative procedures per AR-cycle.

1

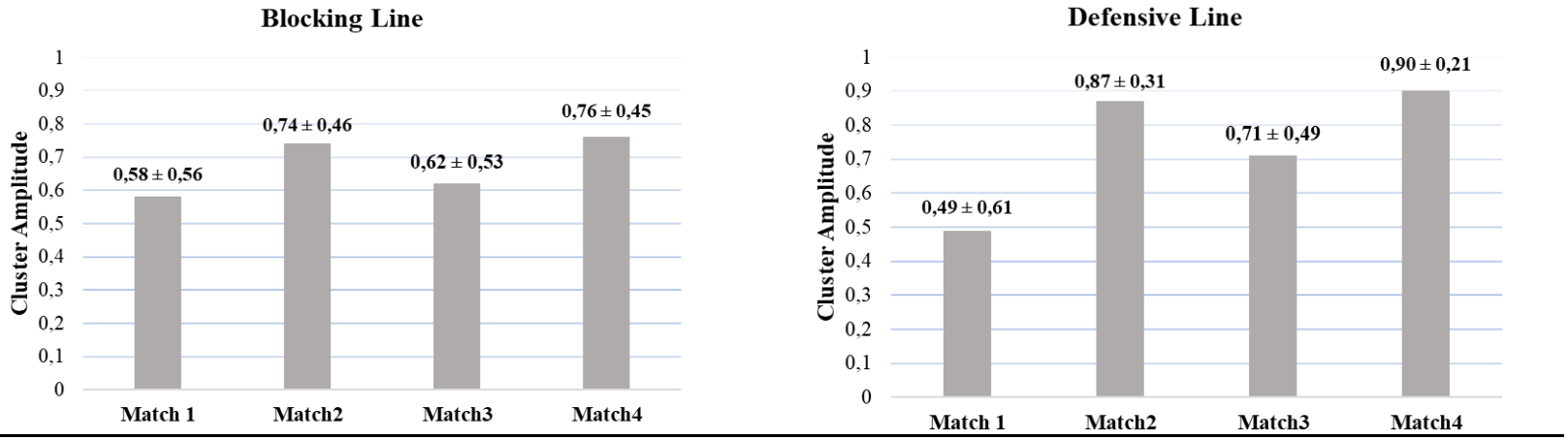

Figure 2. Mean and standard deviation values of lateral cluster-amplitude from match 1 to match 4 as function of blocking and defensive lines.

Table 1. Inter-matches analysis of lateral cluster-amplitude values as function of blocking and defensive lines.

		Blocking Line	**Defensive Line**
		$F_{(3,000)} = 376{,}375$; $p < 0.001$, $\eta_p^2 = 0.09$	$F_{(3,000)} = 1760{,}551$; $p < 0.001$, $\eta_p^2 = 0.31$
Contrast	**M1 – M2**	< 0.001	< 0.001
	M2 – M3	< 0.001	< 0.001
	M3 – M4	< 0.001	< 0.001
	M1 – M4	< 0.001	< 0.001

Response to Reviewer 1

Manuscript: "Tracking relations between development of tactical knowledge and tactical behaviours: A season-long action research study"
ID: CPES-2021-0303

Point raised by referee		Author's Response	Pages & Lines
#	Observation		
General Comments			
1	The authors have done very well to address the feedback of the reviewers, in a considered and comprehensive way, in the table. Despite the revisions, reading the manuscript left me again believing that what is described is more in keeping with Grehaigne and Godbout's Constructivist and Cognitivist Perspective, and that the theorising is unnecessarily complicated by the attempt to provide an ecological-constructivist perspective. Looking at Supplement 2, if you changed the term 'Task Constraints' to 'Game Conditions', all the details look consistent with a game-based approach informed by a constructivist perspective. Similarly, Supplement 3, if you changed the term 'task' with 'game modifications', all the details look consistent with a game-based approach informed by a constructivist perspective. Placing that to the side, the paper is improved by the revisions. However, I believe further work is still required in the Introduction to frame the study and its assumptions.		
Specific Comments			
INTRODUCTION			
2	Page 4	As requested, the reference was replaced	

	Hastie and Mesquita (2016) looked at sport-based physical education and not athlete-centred coaching. The reference is not congruent with the idea suggested – athlete centred coaching from a constructivist perspective. A reference from athlete-centred coaching literature needs to be sourced to replace Hastie and Mesquita (2016).		
3	Page 4 "Grounded on a constructivist paradigm, the Step-Game Approach (SGA) is a player centred approach didactically conceived according to the specific nature of non-invasive team sports, like volleyball" – TGfU included consideration of non-invasive team sports through the game categories, and with relevance to your argument, the net/court games category that includes volleyball. Teaching approaches/models based on TGfU, such as the Game Sense approach and Tactical Games model both published in the mid-1990s, also include pedagogical instruction in the net/court game category. I believe this needs to be acknowledged and therefore your claim to uniqueness also needs to be tempered somewhat unless you can clearly state what the Step-Game model provides pedagogically that TGfU (and GSA, TGM) net/court games scholarly work doesn't provide.		
4	Page 5 "When practically combined". A question arose when I read that: TGfU-Game sense is athlete-centred (Thorpe in Kidman, 2001), and you suggest that like SGA, TGfU has commonly been explained from a constructivist perspective seeking to understanding how players respond to the situated dynamics created by the conditions of play. You describe "CLA is a player-environment-centred approach that seeks to understand how players continuously adapt their tactical behaviours (TB) to satisfy interacting task-individual environmental constraints that emerge during		

	practice and performance". Apart from different supporting theoretical perspectives, pragmatically and pedagogically is there any difference then between TGfU, SGA and CLA purposes?		
5	Page 5 "could provide" – aren't you proposing that it does provide?		
6	The introduction is still mainly focussed on an ecological perspective and doesn't provide sufficient reason for the putting aside of the different epistemologies and associated theoretical framings of pedagogy that arise when considering CLA and non-CLA approaches, other than it "could provide a foundation to explore some novel insights". In your Conclusion, you state you have "the combination of traditionally opposed, yet complementary, approaches (SGA-CLA)". I agree that pedagogically there is complementarity in TGfU, SGA and CLA and that the opposition lies in the epistemology of CLA and game-based approaches. I believe there is still work to do to substantiate the pedagogical complementarity and the utility of epistemological combination in the Introduction to the paper.		
METHODS			
7	Page 8 and 9 "The CLA and SGA principles were integrated" "Pedagogical methods, based on an integration of key ideas from ecological (CLA) and constructivist (SGA) paradigms were utilised by the coach over the competitive season" Supplement 2 and 3 may need to be included as tables in the paper for these sentences to have any real meaning.		