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Towards a contemporary player learning in development framework for sports practitioners

1   Towards a contemporary player *learning IN development* framework for sports practitioners

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14   **Abstract**

15   As it is appreciated that *learning* is a non-linear process – implying that coaching

16   methodologies in sport should be accommodative – it is reasonable to suggest that *player*

17   *development* pathways should also account for this non-linearity. A constraints-led approach

18   (CLA), predicated on the theory of ecological dynamics, has been suggested as a viable

19   framework for capturing the non-linearity of learning, development and performance in sport.

20   The CLA articulates how skills emerge through the interaction of different constraints (task-

21   environment-performer). However, despite its well-established theoretical roots, there are

22   challenges to implementing it in practice. Accordingly, to help practitioners navigate such

23   challenges, this paper proposes a user-friendly framework that demonstrates the benefits of a

24   CLA. Specifically, to conceptualize the non-linear and individualized nature of learning, and

25   how it can inform player development, we apply Adolph's notion of *learning IN development*

26   to explain the fundamental ideas of a CLA. We then exemplify a *learning IN development*

27   *framework*, based on a CLA, brought to life in a high-level youth football organization. We

28   contend that this framework can provide a novel approach for presenting the key ideas of a

29   CLA and its powerful pedagogic concepts to practitioners at all levels, informing coach

30   education programs, player development frameworks and learning environment designs in

31   sport.

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33   **Key words:** Ecological dynamics; learning designs; constraints-led approach; non-linear

34   pedagogy; youth development; knowledge of/about

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Introduction

Talent development has been described as a progressive, mutual accommodation that emerges to enhance the functionality of an athlete in embedded and dynamic sporting and non-sporting environments [1]. As part of this 'progressive mutual accommodation', sports practitioners are often challenged to prepare athletes for the demands of current performance environments, while simultaneously developing their performance capacity for future competition. This challenge is captured within the implementation of practical support activities operating at two integrated timescales: the micro-structure of practice (undertaken hourly, daily, weekly and monthly) and at the macro-structure of talent development (over periods of many years, [2, 3]). Contemporary non-linear pedagogical frameworks, such as the constraints-led approach (CLA), have emerged to theoretically guide practitioners through this challenge [4]. However, there is a need for continued evidence, with deeply contextualized 'real world' examples, to support further and improved up-take of the practical application of the CLA by sports practitioners (for notable examples, see [5-9]).

Better up-take may result from applied scientists improving the communication of key concepts of the CLA, presenting them in ways that are meaningful[1] to practitioners [10]. Up-take effects have also not been helped by some misinterpretations of the CLA in practice [11]. For instance, constraints could be misinterpreted as negative influences that limit skill development by over- or under-constraining practice designs for athletes during development and performance preparation. To avoid (the misconceived) effects of "over-constraining" practice tasks, many coaches elect to adopt a *laissez-faire* (hands off) game-centred approach, whereby the CLA is misconstrued through a 'let the game be the teacher' lens [11]. This is not how the constraints-led pedagogical model conceptualizes the challenges for the learner during the learning process in sport [11, 12].

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[1] Presenting the key concepts of CLA in ways that are relevant to the context, and resonant with the culture, in which practitioners are embedded.

60   In this paper, we aim to support practitioner understanding – of how to overcome

61   interpretative challenges – by offering insights into how, when predicated on key ideas of

62   ecological dynamics and conceptualized through the lens of Adolph's notion of *learning in*

63   *development* [13], the CLA can offer a user-friendly developmental framework. To achieve

64   this, we present a bespoke *learning in development framework*, based on the CLA, that has been

65   established in a high-level youth football organization, informing coach education and player

66   development.

67   **Learning IN development**

68   *Towards a user-friendly interpretation of a CLA to conceptualize player development*

69   Ecological dynamics offers sporting practitioners a transdisciplinary theoretical

70   framework to conceptualize learning, performance and development [14, 15]. More

71   specifically, by blending concepts from ecological psychology [16] and constraints on

72   dynamical systems [17, 18], expertise, skill and talent development can be understood to

73   emerge from the complex and dynamic interactions of an individuals' continuous adaption to

74   surrounding constraints (performer, environment and task), which changes over micro- and

75   macro-timescales [2, 6, 19, 20]. Learning, therefore, occurs during continued developmental

76   changes across the whole life-course, and concerns what the individual does about these

77   changes [13]. This is why Adolph [13] used the phrase learning *in* development preferentially

78   to learning *and* development.

79   As proposed by Renshaw and Chow [10] and as exemplified by both Woods and

80   colleagues [5] and McKay and colleagues [21] when situated within an ecological dynamics

81   framework, the CLA can help practitioners conceptualize the inherent non-linearity of the

82   learner and the learning process in sport. Specifically, it highlights the nature of the continuous

83   complex and dynamic non-linear interactions between a performer (individual), task, and

84 environment [4, 22], while offering an explanation for the emerging behaviors observed in sport

85 through identifying key, interacting constraints [23].

86   The term "non-linear" refers to the notion that small changes in system properties (e.g.

87 the physical, psychological and emotional characteristics of an individual; a team's practice

88 conditions) can lead to large changes in emergent behavior and vice-versa. In other words,

89 changes are *non-proportionate* in non-linear systems, in that slight changes can have large

90 effects on how a complex system behaves [24]. For example, manipulating a task constraint,

91 such as changing the mass and size of a football in youth soccer, may lead to the emergence of

92 qualitatively 'new' actions for exploiting gaps and spaces, which may not emerge when players

93 practice with footballs of different properties[2]. An adult-sized (regulation size 5) football, for

94 example, may still afford a young player the possibility to pass or dribble through the invitation

95 of a gap between two players, but due to its weight and size, relative to the action capabilities

96 of a young player, it may not afford the opportunity to perform certain actions, such as playing

97 (chipping/scooping) the ball over the defenders into spaces behind them. The lack of displaying

98 such specific actions should not necessarily be taken as a 'lack of skill' by practitioners. The

99 introduction of a lighter and smaller ball (scaled to the current properties of the young player's

100 physical system) may, comparatively, afford young players the "chip-ability/scoop-ability" of

101 a ball[3]. With this small change, the value and meaning of the context – and hence the use and

102 motivation for such action opportunities – has changed for the young player due to changes in

103 the individual-environment relationship (e.g. the introduction of a lighter and smaller ball better

104 'fits' the current action capabilities of the young player).

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[2] For example, the constraints of futsal, and specifically the use a Futsal ball has been seen to enhance the development of passing skill in football (see Oppici et al., 2019 for details).

[3] See from 20 seconds for 'real-world' example from AIK youth football https://youtu.be/3rbhWuUsmZM?t=20

105   Essentially, the CLA explains how aspects of each individual, the environment and task

106   interconnect with each other. This forms a complex system that shapes learning in development.

107   These interconnected system features can be conceptualized as constraints because they guide

108   or channel the direction and rate of development by providing the boundaries within which

109   learning happens. A key point here is that constraints do not determine an individual's learning

110   and performance behaviors, but continually interact to guide and shape them [19]. This

111   appreciation sets the foundations for our understanding of the learner and the learning process

112   for each individual's unique developmental trajectory (see Figure 1), helping us to recognize

113   the opportunities a CLA presents.
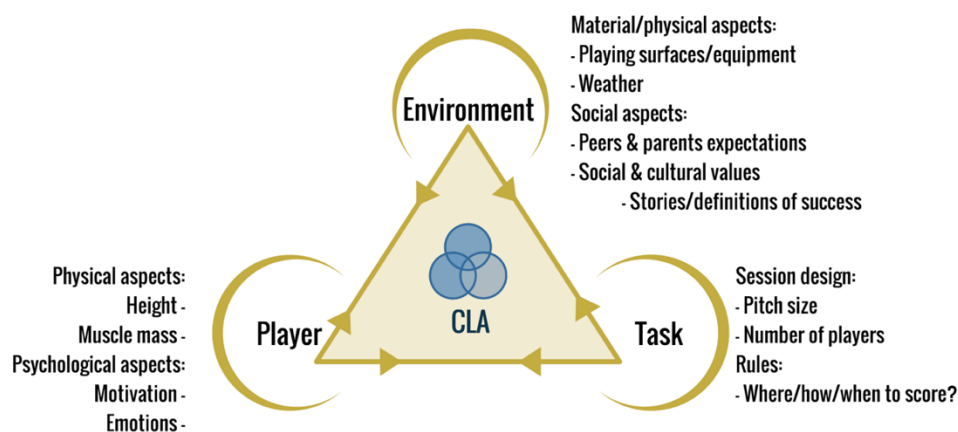

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115   *Figure 1: Adopted from Newell's model of constraints (1986), conceptualizing constraints that shape and guide learning*

116   Critically, while the CLA helps conceptualize how skills emerge, it does not provide a

117   framework for how to design appropriate learning environments in team sports [25, 26].

118   Principles of a non-linear pedagogy (NLP) can address this limitation, supporting practitioners

119   to harness CLA methods in a range of practice task designs [27, 28]. Key principles of NLP

120   can be summarized as: the designing of *representative learning environments* that facilitate

121   opportunities for learners to develop and adapt relevant information-movement couplings,

122   *manipulation of constraints*, *repetition without repetition* (functional movement variability) and

123   the promotion of an *external focus of attention* (for detailed overviews and practical

124   interpretations of a NLP see [5, 28]).

125   The key point here for practitioners is that in this framework, learning is based on an

126   active engagement and interaction of an individual with a performance environment [5], as they

127   learn to attune to environmental information matched to their action capabilities [2].

128   *Knowledge of (in the game) and knowledge about (out of the game)*

129   In building toward his theory of Direct Perception, James Gibson [29] differentiated

130   between *'knowledge of'* and *'knowledge about'* the environment. While both knowledge 'types'

131   (in)directly influence perception, Gibson [29] asserted that *knowledge about* the environment

132   reflects an abstracted and indirect response to things or states of affairs. This type of knowledge

133   is typically evident in verbalized responses to questions about things or in the presentation of

134   pictures or symbols representative of them (i.e., whiteboard scribing that shows players about

135   their positioning in a football game) [30]. In sport, such knowledge, developed through verbal

136   responses to questions or coach-provided declarative instruction, may be useful when

137   describing performance *ex situ*. However, while such knowledge may help initially orient an

138   individual in unfamiliar regions, it does not necessarily support a performer's capability to

139   wayfind[4] during performance, in the same way that reading a recipe does not mean an individual

140   can actually cook or that reading about a plant signifies gardening skill [5, 31, 32].

141   Comparatively, *'knowledge of'* the environment is reflective of embodied-embedded

142   knowledge developed by, and exemplified in, *activities* (e.g. movements, behaviors,

143   performances) that enhance the coupling between perception and action [29]. For the sake of

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[4] "Wayfinding" is a narrative way of learning a landscape. By being embedded into the landscape, an individual progressively learns of its many features (supported by experienced others); understanding how such features can be used to 'find their way'. This anthropological concept has recently been espoused to explain the learning process in sport, through the framework of ecological dynamics. While discussed in more detail later, interested readers could consult Woods et al. [5] for further insight.

144   reaching practitioners across the sporting landscape, we refine Gibson's interpretation and refer

145   to this type of knowledge as "*knowledge in"* the game. So, while young players may display

146   *knowledge about* the game when verbalizing responses to questions posed from a coach or

147   educator, it does not necessarily imply that they can actually perform these actions *in* the game.

148   An important contention of this paper, though, is that practice tasks need to be designed by

149   practitioners with an extensive *knowledge about* the game, as this knowledge *about* collective

150   and individual performance can inform practice designs to support the development of a

151   performer's *knowledge in* the game. So, appreciating this: *how does a practitioner actually*

152   *design practice activities, using the CLA, that develops a learner's knowledge in the game?*

153   *Designing practice tasks that supports "knowledge in" the game*

154   In order to first promote learning 'in the game', practice tasks should be carefully

155   designed to help performers detect information that specifies *opportunities* for action (referred

156   to as *affordances* by Gibson [16]), relative to their current performance capabilities [33].

157   Moreover, practice tasks should help individuals learn how to self-regulate perceptions and

158   emotions to exploit emergent affordances for action. This can be achieved through the

159   deliberate designing in of key affordances with which learners can interact during practice [27].

160   Briefly, affordances can be understood as properties of an individual-environment system,

161   providing opportunities for action, scaled to each individual's action capabilities (e.g. speed,

162   strength) and body dimensions [34]. Humans are surrounded by affordances, which are always

163   available to be perceived when these opportunities for action become meaningful [16]. For

164   example, for some children, a ball is an object with different value and meaning, such as to be

165   avoided, picked up, thrown or kicked. Thus, as there are many possible perceptions and actions

166   in any given situation, practitioners need to guide a performer's *intentions* toward what needs

167   to be achieved in a performance environment [35]. In doing so, practitioners can educate the

168   *attention* of players toward the perception and realization of key affordances available in the

169   environment [11].

170   Next, through the lens of Adolph's notion of *learning in development* [13], we present a

171   user-friendly developmental framework for practitioners grounded in ecological dynamics,

172   which is currently being used by AIK Youth Football in Sweden.

173   **A proposed learning IN development framework**

174   *An example at AIK Youth Football*

175   AIK Youth football (Allmänna Idrottsklubben) is based in Solna, Stockholm and engages

176   over 1500 players between 5-18 years of age. In April 2017, after disbanding its early talent

177   selection policy, an in-house investigation, conducted by professional coaches and sport

178   scientists using ethnographical strategies, was carried out to inform present and future

179   possibilities of evolving practice and player development. Specifically, a contribution of

180   observations, field notes, document analysis and unstructured interviews connected the actions

181   of coaches (e.g. coaching styles) and young players at AIK youth football with the socio-

182   cultural and historical contexts within which an individual's development occurs. Two case

183   studies were undertaken to assess the wider socio-cultural contexts and historical influences on

184   player development [for specific examples, see 5, 36].

185   We noted that structure of development pathways and implemented pedagogies went

186   hand-in-glove (for better or worse), with the skills and attributes appreciated in young players

187   being culturally embedded, founded upon specific socio-cultural and historical constraints (for

188   further reading see [5, 20, 36]). For example, global-to-local (i.e., top-down) processes were

189   amplified in a coaching culture, where team organization and the notion of an 'optimal'

190   technique had previously been prioritized over developing players' *knowledge in* the game.

191   To soften these path dependencies, there was a need for contemporary, theoretically

192   driven frameworks of player development (which were able to transcend historical or cultural

193   tendencies) [5, 37, 38], inviting practitioners to appreciate the underpinning principles of a

194   rationale grounded in non-linearity [10, 38]. Recognizing that macro level (i.e., wider socio-

195   cultural contexts) sociocultural constraints evolve over years and can be challenging to

196   influence, initial interventions were focused at the micro level of practice task design [39].

197   Grounded in the theoretical framework of ecological dynamics, coaches were encouraged to

198   adopt principles of a CLA to support player development.

199   In the continued and iterative effort to present the key ideas of a CLA and its pedagogic

200   concepts to practitioners at all levels, the user-friendly *learning in development framework*

201   (Figure 2) and *foundations for task design model* (Figure 3) were developed. The cycle

202   illustrated in Figure 2 depicts a conceptualization of the key aspects of learning in development,

203   while Figure 3 provides a brief insight into some foundations for football specific task design

204   based on key principles of NLP. The key aspects of Figure 2 are categorized into three phases

205   relating to the timing and timescales of development at macro and micro levels, as well as the

206   coaches role in guiding the players' development. The following sections unpack the three

207   phases of the learning in development framework shown in Figure 2, while drawing on the

208   summary of foundations presented in Figure 3 to help conceptualise it in practice.
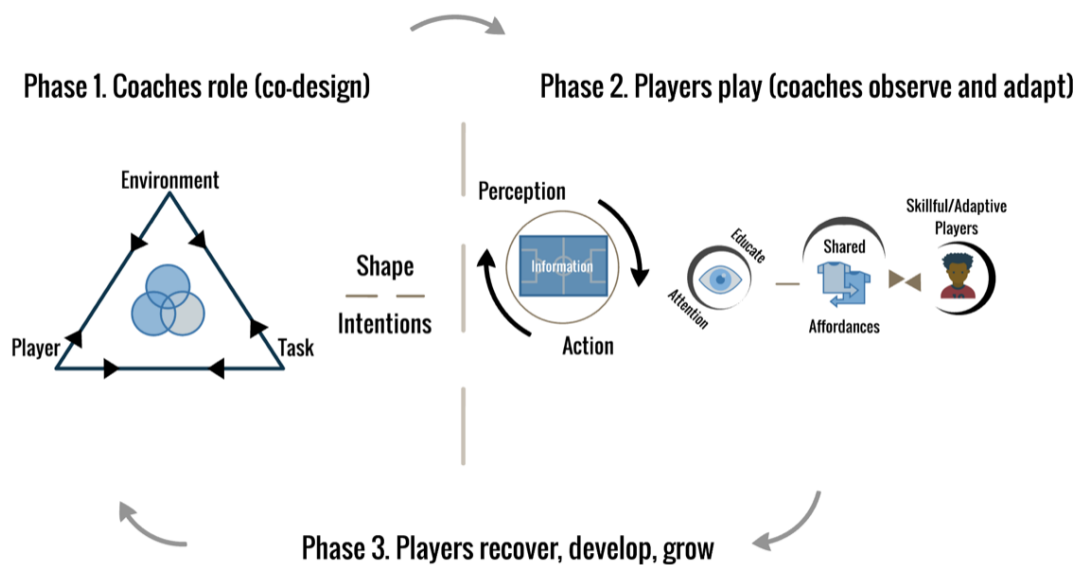
Phase 1. Coaches role (co-design)   Phase 2. Players play (coaches observe and adapt)

Phase 3. Players recover, develop, grow

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Figure 2: The three phases of the Player learning IN development framework, part of AIK football club's player development cycle.
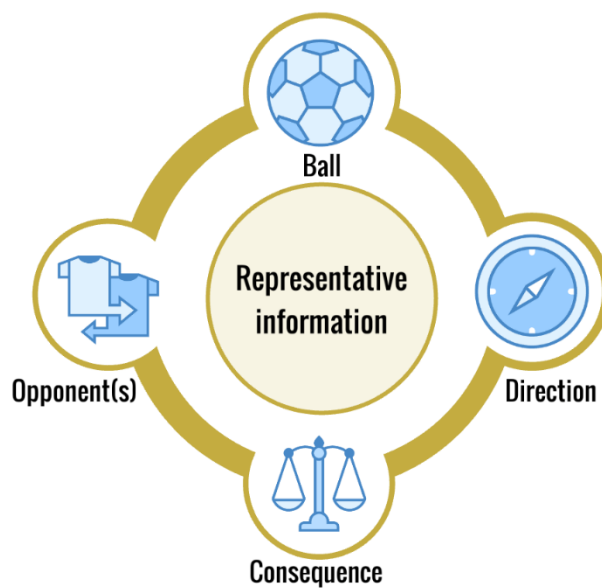

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Figure 3 Foundations for task design model. Ball-opponent(s)-direction are key aspects of task design that shape learners' intentions and attention. The idea of consequence (e.g., if we lose the ball and do not win it back, the opponents may score), highlights the continuity and co-adaption of attack and defence. Key information in task design is representative of the game.

Phase One

Phase one illustrates that the coaches role in this framework is to *co-design* a training session that develops a player's *knowledge in* the game (Figure 2). Coaches at AIK are

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219 encouraged to dampen the sociocultural constraints (previously identified traditional

220 perspectives) that advocate a constant prescription of declarative *knowledge about* the game, to

221 become a facilitator of activities that place the performer-environment interactions at the core

222 of their practice designs [40]. In doing so, learners are actively encouraged to explore the

223 information that is available in their performance landscapes, deepening their *knowledge in* the

224 game and its possibilities for (inter)action [5, 41].

225 Based on the tenets of the CLA and NLP, the coach manipulates task constraints, being

226 responsive to environmental and socio-cultural constraints, to shape intentions that frame the

227 players perception and action. In this framework, co-design alludes to each performer's input

228 in the learning process (and recognition of their unique constraints), both implicitly and

229 explicitly. The implicit input relates to a sport practitioner's knowledge of the performer's

230 current action capabilities. For example, the pitch dimensions, and ball and goals should be

231 scaled to the physical constraints of the performers. Also, the number of players involved in

232 practice tasks can be scaled down and constraints can be added to shape available affordances

233 (e.g. gaps and spaces: influencing spatial-temporal dynamics) that afford more representative

234 football interactions [5] (such as passing, manipulating the ball and dribbling in spaces and

235 between players). The explicit co-design process is evident when adapting the session to the

236 players intentions based on observations made during the session. To shape intentions and/or

237 shine a light on an area for greater attention, a coach might manipulate task constraints by

238 changing playing area dimensions, as well as adding or removing rules, players, zones and

239 goals. This explicit co-designing of task constraints may also take place through actively

240 involving the performers in decisions on the design of further adaptations of the learning task

241 (for a detailed insight to principles of representative learning design, refer to [42]).

242 The foundations for task design graphic is suggested to provide principles for how

243 coaches can design and evaluate 'football'-specific learning environments (Figure 3). Indeed,

244   a design may satisfy the criteria of *ball-opponent(s)-consequence*, yet still violate the

245   criteria of *information in task design is representative of the game*. For example, the rule

246   that all players must touch the ball before a goal is scored may not be a representative task

247   constraint [28], as it may not promote effective perception-action couplings in relation to

248   relevant affordances available in the performance environment. In this case, the team in

249   possession may not be attuning to the information that supports them in exploiting gaps and

250   space so that they can penetrate and score.

251   Given this attunement to information to regulate action, learning, within this framework,

252   can be understood as wayfinding [30] – an explorative process in which an individual learns to

253   solve problems by detecting information in their environment of use for specifying (regulating

254   and (re)organizing) actions. This perspective of the learning process is characterized as a

255   progressive *education of attention* (helping each performer become attuned to the information

256   in a specific performance environment), which is predicated on Gibson's [16, 29] perception-

257   action coupling approach for understanding how humans regulate behavior. For example, a

258   coach observing a small sided game might want to promote the utilization of gaps and space

259   via dribbling without denying the opportunity for passing. Adding a task constraint such as

260   awarding a point to the team who is able to intercept a pass, places a risk on passing but does

261   not exclude its utility. When in possession, this risk could invite players both with and without

262   the ball to self-organize their individual and collective behaviors to support the player in

263   possession. While the targeted intention with the task constraint is to shine a light on

264   opportunities to dribble without removing the opportunity to pass, it also invites opportunities

265   for teammates to continuously adapt their positions to local information (e.g. player in

266   possession, and positioning of nearest opponents).

267   However, as suggested by Woods and colleagues [5], rules and verbal instructions

268   utilized by coaches can have an over-constraining influence on player interactions and

269 intentions, guiding the player's attention to non-representative information sources. For

270 example, a practice activity designed on encouraging 'overlaps' may be traditionally over-

271 constrained by using a rule that you *must* pass to the overlapping player (to score). In this

272 case, the defending team need only defend the overlap (therefore, they would just need to

273 self-organize their interactions around the overlapping player to complete their task),

274 especially if the coach announces the (over)constraint to the whole group. Such

275 announcements are common when coaches declare what the theme of a certain session will

276 be (i.e., overlaps). This prescriptive approach could promote an inherent lack of

277 representativeness and ensuing predictability, limiting variability and thus possibilities for

278 players to learn how explore the learning environment, to develop and exploit crucial

279 information-movement couplings to coordinate their actions. For example, the idea of a

280 successful overlap is not limited to an overlapping player receiving the ball, but its value

281 includes distracting the defenders, pulling them out of position and creating other affordances

282 for action. For example, there may be opportunities to exploit gaps more centrally, or on the

283 inside of the defender nearest the overlapping player. Should these affordances be ignored

284 just to comply with a coach's prescriptive instructions on how to perform? Essentially,

285 practice activity designs should *invite* opportunities for players to learn how to fine tune their

286 attention (e.g. what information to attend to in a performance context) [43]. Thus, if an external

287 influence (i.e., declarations of a coach) reduces attunement to the information available in an

288 environment through an over-constraining instruction or rule, then the opportunity for players

289 to learn to exploit relevant, available information (by searching) may be limited. So, rather than

290 imposing rules, a coach may challenge players to utilize their teams time in possession to create

291 possibilities to play through, around or over the opposition. In other words, coaches could guide

292 player intentions towards individually and collectively exploiting gaps and space to score a

293 goal. The key point here is that phase one of this framework conceptualizes the coach's role as

294 fostering player-environment interactions through carefully co-designed practice tasks.

295 Constraints used in this conceptualization should guide, shape or encourage actions, not

296 necessarily eradicate, prescribe or dictate them.

297 *Phase Two*

298 The second phase of this framework relates to the player, as they are encouraged to tighten

299 perception-action couplings through the progressive detection of information and

300 (re)organization of action. As explained earlier, the coach can manipulate task constraints and

301 shape intentions to (re)frame a player's perception-action coupling. However, coaches should

302 be cautious of relying too heavily on augmented informational constraints, such as verbal

303 instructions provided to players [44]. For example, if uncoordinated defending (e.g. defending

304 at the same time but not together) is making an activity unrealistic, a coach might verbally

305 clarify the players' intentions and task goal when defending (i.e., "*our first priority is to stop*

306 *the opposition playing through, around or over us, while our second priority is to press to win*

307 *the ball*")[5].

308 This guidance could also be achieved in numerous ways by manipulating the task design,

309 such as the defenders lose accumulated points if the opposition play through them, but they

310 only gain points by pressing and winning the ball. For the players "in possession of the ball",

311 the intention to play through shines a light on opportunities for playing penetrative passes in

312 the landscape of shared affordances to pass and receive between the defenders [45]. But for the

313 defenders, the shared affordances perceived would relate to opportunities for pass interception

314 and the closing of spaces for opponents to play penetrative passes.

315 *Phase three*

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[5] However, it is important to note that players learning is limited 'out' of the game, so any verbal instruction that requires the coach to stop the game should be minimized. This is not to say that verbal instruction is explicitly 'bad', though.

316   The third phase of this framework captures the process of recovery and adaptation to

317   training session(s). Over typical timescales of learning (days, weeks, months, years), this

318   adaptation will change the action capabilities of the player, as they learn in development.

319   Importantly, continued player development will re-shape this whole cycle and the co-design

320   process, emphasising the dynamics of this learning process in this development framework.

321   Something for the coach to reflect on when planning practice task designs throughout these

322   different timescales (weeks, months, years), is that the perception of affordances changes as an

323   individual's capability for action changes. This is because, although an affordance is always

324   available in the environment, its value and meaning for each individual may change as the

325   individual matures, develops and grows [16]. Youth soccer performance environments are

326   dynamic and competitive, requiring young players to learn to adapt and develop innovative

327   solutions by continuously seeking and perceiving opportunities for action in the performance

328   environment [46, 47]. The nature, type, and complexity of these settings change with learning

329   in development as certain available affordances in the environment become more soliciting or

330   inviting than others [48]. For example, with maturation and development, specific action

331   opportunities emerge for young players (e.g. being able to play a long pass over the heads of

332   opponents into space behind them) or being able to shoot past the goalkeeper from a distance

333   away from the goal.

334   **Limitations and challenges of this framework**

335   There are some noteworthy challenges and limitations in introducing the knowledge and tools

336   to base a coach education program and player development framework on the key principles of

337   the CLA to a sports organization. Firstly, this approach takes time to learn for practitioners,

338   with an understanding of key theoretical concepts needed. This time investment is not always

339   prioritised within sporting environments, for a variety of reasons. Secondly, there may also be

340   practical obstacles to overcome along the way – financial barriers and stakeholder expectations

341 perhaps being a couple. Thirdly, local knowledge about the sport and the socio-cultural context

342 in which the sport is carried out is required. This knowledge helps practitioners to understand

343 and identify the socio-cultural constraints that may be shaping the club structure, parental

344 expectations, coach pedagogy and session design. The growth of this knowledge, however, is

345 likely to take time – meaning that the framework presented here may provide a basis for which

346 an interested reader could initiate the pedagogical integration process, but not an end point.

347 **Concluding Remarks**

348 In summary, this paper proposed a framework to support the practical application of the CLA

349 in youth football. It highlighted some relevant concerns that challenge the integration of such

350 methodologies, limiting their impact on coach education programs and player development

351 pathways, such as the need to improve the communication of key concepts and the recognition

352 of misinterpretations. While appreciating there is still work to be done, it is hoped that the

353 framework we presented does address some of these challenges for practitioners. Thus, the

354 purpose of this framework was twofold; first, to help practitioners conceptualize the inherent

355 non-linearity and highly personal nature of learning in order to inform player development

356 pathways, and second, to show how to integrate a CLA in practice task design. This discussion

357 was intended to guide practitioners towards a more flexible and adaptable approach to planning,

358 where, through the implementation and refinement of task designs, they could continually

359 assess and evaluate each individual's needs (within a team) over various timescales of

360 development.

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