

Conceptualizing Physical Literacy within an Ecological Dynamics Framework

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1 **Conceptualizing physical literacy within an ecological dynamics**

2 **framework**

3 **Abstract**

4 Currently, there are numerous definitions and interpretations of the concept of
5 physical literacy within the literature, potentially leading to a lack of consensus
6 as to how to employ it in practice. In this position paper, we argue that
7 ecological dynamics is well-positioned to provide a theoretical framework that
8 will bring clarity, as well as support the operationalisation of physical literacy in
9 practice. We argue that this theoretical conceptualisation provides an excellent
10 framework for understanding physical literacy because of its emphasis on the
11 person-environment relationship. More directly, we propose the establishment of
12 an *individual-environment fit* across varied movement contexts over a lifespan as
13 a central tenet of the physical literacy concept. We conclude by discussing how
14 sports practitioners, national governing bodies, public health and education
15 sectors could re-design sport, exercise and physical activity environments, in
16 accordance with an ecological dynamics rationale to enhance physical literacy.

17 **Key words:** Individual-environment fit; non-linear pedagogy; functional skill
18 adaptation; self-regulation; affordance landscapes; environment design

19

20 **Introduction**

21 Recently the concept of physical literacy has gained increased attention beyond physical
22 education, sport discourse and into the public health arena (Young, O'Connor & Alfrey,
23 2019; Jurbala, 2015), entering policy and practice in many countries (Spengler &
24 Cohen, 2015). Physical literacy is not a new term, having been referenced as early as
25 the 1900s (Corbin, 2016). However, it was Whitehead's conceptualisation emerging
26 from the physical education literature in the United Kingdom (Whitehead, 2001) that
27 initially stimulated interest and usage among practitioners and academics. Whitehead
28 defined physical literacy as 'the motivation, confidence, physical competence,
29 knowledge and understanding to value and engage in physical activity for life' (IPLA,

2017). This holistic approach to physical literacy rejected the Cartesian view of the mind and body being separate entities, instead promoting the idea of *embodiment* (Whitehead, 2007). Whitehead argued that sport and physical activity represents just one context in which embodied capacities are both challenged and celebrated throughout an individual's lifespan (Whitehead, 2001, 2007; Whitehead & Murdoch, 2006). This capacity to capitalise fully on our embodied dimension could be captured in the term 'physical literacy' (Whitehead, 2007).

The increased interest in physical literacy has mirrored that of physical activity epidemiologists from academic institutions, public health departments and the World Health Organization who have highlighted that 1.4 billion adults do not meet the WHO recommended levels of physical activity (Guthold, Stevens, Riley, & Bull, 2018). This number will continue to rise in years to come, as it has been predicted that by 2030 in the United States of America: (i) 1 in 2 adults will be obese; (ii) the prevalence of obesity will be higher than 50% in 29 states and not below 35% in any state; and (iii), nearly 1 in 4 adults is projected to have *severe* obesity by 2030. In response to the health consequences and financial economic burden, which is estimated to be over £50 billion per year, enhancing physical literacy has been seen as a key focus in policy to integrate public health, recreation, sport, and education agencies to engage youth into a life of physical activity (Dudley, Cairney, Wainwright, Kriellaars, & Mitchell, 2017).

Physical literacy and its definitional vagueness

A problem for those interested in promoting the construct has been the emergence of many different interpretations of physical literacy (see Edwards et al., 2016, Shearer et al., 2018; Young, O'Connor, & Alfrey, 2019). This has led to a lack of consensus as to how to define and employ it in practice (Foulkes, Foweather, Fairclough & Knowles,

54 2020; Hyndman & Pill, 2018; Jurbala, 2015), seemingly resulting in an
55 oversimplification of the concept (Whitehead, 2010). For example, McKenzie and
56 Lounsbery (2016) identified that many practitioners cannot discriminate between
57 physical activity, physical fitness and physical education, and that adding another term
58 such as physical literacy could increase confusion. Further, likening movement
59 ‘literacy’ with language ‘literacy’ may be problematic (Jurbala, 2015). Designed to
60 appeal to educators, managers and policy makers (Jurbala, 2015), the construct has been
61 promoted in the media through the notion that children should be taught physical
62 literacy in the same way that they learn numeracy or grammatical skill (Addley, 2019).
63 Arguably, this adopted perspective positions the term as a testable or measurable
64 phenomenon, whereby generic assessments that reflect the traditional standardised
65 testing of reading, arithmetic and writing may suffice to understand its ‘acquisition’ by
66 an individual (Tremblay & Lloyd, 2010).

67 Indeed, physical literacy test objectives have been questioned for their inadequate
68 simplistic linear methodologies and designs that attempt to reduce movement into
69 measurable components, while showing a lack of appreciation for the contexts in which
70 movement takes place (Edwards, Bryant, Keegan, Morgan, & Jones, 2016; Ng &
71 Button, 2018). Physical literacy, in this sense, provides a reductionist or ‘textbook’
72 application of a source of representational knowledge which needs to be applied in a
73 practical settings in checkbox fashion (Roberts, Newcombe, & Davids, 2018). Jurbala
74 (2015) challenged these approaches when he argued that physical literacy can instead be
75 viewed as a journey throughout a lifespan that extends beyond formally-organised and
76 competitive sports and physical education. Through such a lens, physical literacy is not
77 viewed as a series of ‘acquired’ movement competencies and skill components, but a

78 continually evolving concept that could positively impact the mental and physical
79 wellbeing of individuals throughout childhood, adulthood, and into old age.

80 **Physical literacy policy across the world**

81 Despite its definitional vagueness, popularity of the concept of physical literacy among
82 sport and physical activity practitioners and policy makers continues to grow (Jurbala,
83 2015), with many publication on the construct often produced by government funded
84 organisations and departments (Lynch, 2019). For example, in Canada it has been
85 placed as ‘the cornerstone of both participation and excellence in physical activity and
86 sport’ (Way, Balyi, Trono, Harber, & Jurbala, 2014, p. 23). A comprehensive approach
87 has been taken in Australia, reducing physical literacy to 30 elements across four
88 physical literacy domains (physical, psychological, social and cognitive), accompanied
89 by a five-step, staged approach for implementation (Sport Australian, 2019). In
90 England, physical literacy has been reduced to a set of capabilities and achievements
91 that every child should achieve (Sport England, Strategy, 2016), while in Sweden,
92 Lundvall and Tidén (2013) have shown how physical literacy has been integrated into
93 physical education as a form of generic assessments. It is apparent that many
94 government policy programmes of physical literacy are underpinned by stage-based
95 models of movement development, with a focus on measurement, that are seemingly
96 grounded in health-based epidemiological models of physical activity promotion. For
97 example, fundamental movement skills have been promoted within physical literacy
98 under the assumption that they are associated with an initiation in to competitive sport
99 and health, while uncritically been accepted as central to physical education (Almond,
100 2014). Such an approach to physical literacy moves the primary focus away from the
101 learning process, enhancing understanding of how to enrich self-regulation in
102 movement contexts, towards evaluation of outcomes. Measurement choices are made

103 based upon psychometric properties of assessment feasibility, reliability and validity
104 (construct, predictive, convergence) (Cools, Martelaer, Samaey, & Andries, 2009;
105 Webster & Ulrich, 2017). However, relevant forms of validity are not well-understood,
106 such as face and content validity, that would question whether the assessment is valid
107 under scrutiny of contemporary theories of motor learning and development.

108 To summarise so far, the concept of physical literacy, despite its definitional
109 vagueness, is becoming an integral component of national health policy and a key focus
110 of the physical education curricula across the globe. It is seemingly doing so through a
111 health-based model of physical activity. This perspective moves away from enhancing
112 understanding of the motor learning process, perhaps leading to a paucity of evidence to
113 support how practitioners may integrate it in curricula and erecting barriers to its utility
114 (Roberts, Newcombe, & Davids, 2018, Rudd et al., 2020).

115 **Towards a theoretical framework to enhance the conceptualization of physical** 116 **literacy**

117 We propose that these misconceived conceptualisations and the definitional vagueness,
118 in part, may be due to a lack of a persuasive, comprehensive theoretical grounding. To
119 assist in the conceptualization of physical literacy situated in an ecological dynamics
120 framework, in Table 1 we outline the synergies that may exist between Whitehead's
121 (2001) original definition of physical literacy and an ecological dynamics rationale.

122 See Table 1

123 Ecological dynamics moves us beyond describing what physical literacy is, towards
124 guiding practitioners by supporting how they can operationalize the concept. This is
125 because the emphasis is on the person-environment relationship, and the value of
126 adopting that interaction as the scale of analysis. This scale contrasts with perspectives

127 that examine physical literacy effects on the individual or environment considered
128 separately and so is better aligned with the philosophical and embodied nature of
129 physical literacy put forward by Whitehead (2007).

130 Advancing physical literacy is therefore a journey of individual enrichment
131 through movement experiences in a variety of movement contexts. A wide variety of
132 rich interactions with varied environments ranging from quality organised sports to
133 recreational physical activity experiences will lead to *self-regulation* (i.e., an
134 individual's ability to adapt and organise functional behaviours independently, i.e.
135 without the external input of a coach, teacher, or parent) (Chow, Davids, Shuttleworth,
136 & Araújo, 2020; Button, Seifert, Chow, & Araújo, 2020). The shared intentionality
137 across sporting and physical activity landscapes should be about supporting self-
138 regulation, thus supporting the individuals' continued physical literacy across a lifespan.
139 More directly, if we are to embrace the concept of physical literacy, then it should be
140 viewed not as an outcome-oriented end-point, but presented as a process-oriented
141 journey across the lifecourse, influenced by a unique set of interacting constraints
142 encountered by each individual. As we elucidate next, negotiating the emergent,
143 interacting constraints in a life trajectory is the challenge for each self-regulating
144 individual seeking a more functional (i.e. fruitful, engaging and productive) relationship
145 with varying performance environments over the lifecourse (Rudd, Pesce, Strafford &
146 Davids, In Press).

147 **An ecological approach to the concept of physical literacy**

148 Through supporting functional interactions of the dynamic elements of behaviour (i.e.,
149 activities, relationships, and settings), the long-term outcomes of positive youth
150 development (i.e., performance, participation, and personal development) are likely to

151 be achieved (Allan, Turnnidge, & Côté, 2017). Through development, a child's varied
152 movement contexts provide different opportunities for (inter)action that are fundamental
153 to promoting motor competence (Flôres, Rodrigues, Copetti, Lopes, & Cordovil, 2019),
154 with these contexts inviting, permitting or inhibiting interaction (Bronfenbrenner &
155 Ceci, 1993). This process, of course, extends into adult life and is relevant throughout a
156 lifespan, with the manifestations of the process and outcomes (each individual's
157 performance levels and aspirations will differ) needing to be tailored to the individual's
158 needs, capacities, desires and stage of development. So, if the concept of physical
159 literacy is to be woven into health education, sport and recreation, in both policy and
160 practice, then it needs to be conceived, like motor skill 'adaption', as a dynamic system
161 that should be viewed as a lifelong, individualised process (Allan et al., 2017; Clarke,
162 1995).

163 An ecological perspective is ideally suited to frame this process, since this
164 ontology implies that physical literacy should be understood not as an entity, and should
165 certainly not be merely implicated with physical movement outcomes. Rather, physical
166 literacy should be reflected in the dynamic, emergent behaviours (i.e., physical, social,
167 emotional, social, cognitive, perceptual) of each individual-environment system,
168 continuously subjected to the influence of changing personal and environmental
169 constraints. The focus is on interacting dimensions of movement and physical activity
170 behaviours (i.e., perceptions, cognitions, emotions, social interactions and physical
171 actions) which emerge to support an adaptive functional, dynamical relationship
172 between the individual and his/her environment (Araújo & Davids, 2011). In ecological
173 dynamics, the term 'functional' refers to the adoption of supportive, adaptive, and
174 relevant behaviours with respect to achieving intended task goals during performance
175 (Davids, Araújo, Hristovsk, Passos, & Chow, 2012). This systems approach calls for a

176 shift in perspectives, from ‘fundamental’ to ‘functional’, from the reductionist
177 interpretation of physical literacy discussed previously, to one which facilitates the
178 systemic emergence of greater functional relationships between the learner and the
179 environment over a lifespan (Renshaw & Chow, 2018). As noted earlier, self-regulation
180 is the means by which appropriate levels of functionality are achieved in different
181 performance contexts (from recreational to elite) requiring an individual to use
182 perception, action and cognition to interact with a performance environment (including
183 its social, emotional and physical dimensions) during goal-directed behaviour.

184 *Ecological dynamics: Appropriateness for framing physical literacy*

185 Ecological dynamics is an integrated theoretical framework (Araújo, Davids, &
186 Hristovski, 2006) of use for studying human behaviour in performance contexts such as
187 work, education and sport, through the lenses of constraints on dynamical systems
188 (Newell, 1986; Kelso, 1995), ecological psychology (Gibson, 1966, 1979), the
189 complexity sciences (Edelman & Gally, 2001) and evolutionary science (for an
190 overview, see Button et al., 2020). Fundamentally, an ecological dynamics rationale
191 views perceptions, cognitions and actions as interacting and self-organising phenomena
192 that emerge from the cyclically dynamic interaction between an individual’s action
193 capabilities and the opportunities or invitations for action (referred to as *affordances*)
194 offered by a specific performance environment (Araújo et al., 2006; Button et al., 2020;
195 Chow et al., 2020; Ross, Gupta, & Sanders, 2018). Within this framework, the
196 environment is perceived in behavioural terms, where objects, places, surfaces, events
197 and other people, provide different opportunities or invitations for (inter)actions.

198 Affordances can be understood as properties of an individual-environment
199 system, scaled to each individual’s action capabilities (e.g., speed, strength), body

200 dimensions (Davids, Araujo, Vilar, Renshaw, & Pinder, 2013), and are perceived by the
201 individual as they learn to establish an individual-environment fit. This idea of a *fit*
202 between each individual and a performance environment highlights the idea that
203 humans perceive the environment in relation to its functionality, and its meaningfulness
204 detected in affordances, which provides insights in to what they learn and know and
205 how they can decide to act (Araújo et al., 2006). Thus, an ecological dynamics
206 framework enables the appreciation of how behaviours emerge at the ecological scale of
207 analysis, the individual-environment relations (Araújo et al., 2006). This appreciation
208 highlights the reciprocity of an individual and the environment coupled as a dynamical
209 system (Warren, 2006), which was eloquently described in the seminal work of Gibson
210 (1979, p. 223) when he stated “we must perceive in order to move, but we must also
211 move in order to perceive”. As we will discuss next, it is the *individual-environment fit*
212 that should form the crux of how we understand and integrate the concept of physical
213 literacy in education and training programmes.

214 *Constraints on the individual-environment fit*

215 Viewing physical literacy as establishing and enhancing an individual-environment fit
216 across varied movement contexts over a lifespan captures the construct not as an as end
217 point, but as a continued journey influenced by a unique set of interacting constraints
218 imposed upon an individual. From this perspective, learning to skilfully navigate a task
219 or performance setting can be understood as the gradual emergence of an adaptive,
220 functional relationship between an individual and his/her environment (Renshaw &
221 Chow, 2018), satisfying a confluence of interacting constraints over a lifespan (Davids,
222 Araújo, Vilar, Renshaw, Pinder, 2013).

223 Constraints shape coordinative patterns within human movement by acting as
224 boundaries or limits within which movement systems emerge (Clark, 1995; Kugler,
225 1986). Constraints were first categorised by Newell (1986) as Individual (e.g., height,
226 weight, speed, motivation, emotions), Task (e.g., specific to the activity to be
227 performed, goal of task) and Environmental (e.g., light, temperature, facilities, social
228 values and societal/cultural expectations) in nature. These three classes do not operate in
229 isolation, rather, they interact and evolve over varying timescales of performance.
230 Movement coordination from an ecological dynamics perspective, results as an
231 emergent property from interacting individual, task and environmental constraints
232 (Seifert, Button & Davids, 2013). This connotation implies that constraints can be
233 manipulated and exploited to provide opportunities (affordances) for actions to emerge.

234 *Physical literacy as an individual-environment fit*

235 From an ecological dynamics perspective, the concept of physical literacy may be best
236 defined, not in terms of the person or the environment, but rather as their degree of
237 “(mis)fit”. The level of analysis is the reciprocal interactions between characteristics of
238 each individual and an environment. This perspective avoids problems with defining
239 physical literacy as a characteristic of an individual (referred to as an ‘organismic
240 asymmetry’, see Dunwoody, 2006; Davids & Araújo, 2010), or as a characteristic of the
241 environment.

242 A good example of this is how we can frame ‘motivation’ within a particular
243 individual-environment relation. In order to meet the psychological needs of the
244 individual, an ecological dynamics rationale proposes the adoption of the principle of
245 self-organization under constraints manipulation (Renshaw, Oldham, & Bawden, 2012).
246 This approach has been shown to be effective in helping learners to acquire skills and

247 maintain a high level of engagement and motivation in sport and physical education
248 contexts (Moy, Renshaw, & Davids, 2014; Moy, Renshaw, Davids, & Brymer, 2015).
249 Indeed, the concept of affordances moves the notion of motivation in a different
250 direction away from the more traditional organismic view of being dependent on an
251 internal process towards something, not necessarily intrinsic, but shared with the
252 environment (E. J. Gibson, 1997). Gibson (1979) considered motivation more broadly
253 as objects, surfaces, events or other people that have value and meaning (or not) for
254 each individual and this can change with experience and a person's needs. The
255 affordance is not changed, but the value or meaning (and hence the motivation to use an
256 affordance or not) changes for each person-environment relationship as individual needs
257 change. So, a well-designed activity or environment, where individuals are invited to
258 learn about affordances through choosing the level of difficulty, will encourage
259 individuals to develop their ability to interact with their immediate environment and
260 modify behaviors in response to changes in body, skills, environment or task (Adolph,
261 2019).

262 So, physical literacy can be understood as the degree to which properties of each
263 individual and environmental characteristics match in varying contexts over a lifespan.
264 In this way, physical literacy, conceptualized as the functionality of the fit between an
265 individual and the environment, is a work in progress; a nonlinear, dynamic relationship
266 which can regress, stabilise or progress, depending on the experiences undertaken over
267 the lifecourse.

268 Both distal and proximal influences impinge on the individual-environment fit.
269 Distal determinants (e.g. national, institutional, political, socio-cultural and socio-
270 economical) are more stable (Flay & Petraitis, 1994), and can play an indirect influence
271 on proximal factors (e.g. playgrounds, sports clubs, amenities, open spaces). The

272 individual-environment fit, for better or for worse, will primarily be reflected in the
273 proximal environment given its immediacy and emotional salience to human beings
274 (Bradley & Corwyn, 2004). Throughout growth and development, the nature, type and
275 complexity of these immediate settings change, as certain environmental affordances for
276 movement become more inviting than others. New physical, social and cultural
277 characteristics invite, permit or inhibit reciprocal interactions that establish the
278 individual-environment fit (Bronfenbrenner & Ceci, 1993). Accordingly, while it can be
279 understood that affordances vary with learning and development (E. J. Gibson & Pick,
280 2000), they are just as deeply sociocultural as they are related to an individual's action
281 abilities (Rietveld & Kiverstein 2014; van Dijk & Rietveld, 2017). For example,
282 sociocultural constraints might limit the opportunities for (inter)actions invited of
283 individuals to access contexts where they could practice a skill. The reductionist and
284 linear idea that if we teach the fundamental movement skills (such as the overarm
285 throw) it will develop perceived competence in individuals, which will lead to seeking
286 out performance opportunities in specific throwing games, which will eventually lead to
287 playing sports involving throwing, does not address sociocultural and/or environmental
288 barriers. Thus, an understanding of the individual-environment (mis)fit across varied
289 movement contexts over a lifespan should, therefore, be a central tenet of the concept of
290 physical literacy.

291 *Physical literacy as a constant evolving state*

292 An ecological dynamics framework involves the appreciation of the whole body
293 (embodied) in close relationship with opportunities for action offered by the
294 environment (embedded) (Araújo, Davids & Renshaw, 2020). Thus, the current status
295 of the body and the environment shapes biomechanical constraints on task performance.
296 For example, Adolph and colleagues (2018) suggested that when infants are learning to

297 walk, their behaviour is continually shaped by the immediate context (i.e., changes in
298 their bodies and in their physical and social environments they are experiencing). These
299 interacting constraints on motor behaviours extend through infancy, childhood and
300 adolescence, and in to adulthood, as individuals' action capabilities and the nature, type
301 and complexity of the affordances within their environment are continually changing.
302 This process also highlights the sociocultural constraints that influence individuals,
303 where experiences are shaped as much by the social milieu as they are by each
304 individual's physiology, anatomy or psychology (Uehara, Button, Falcous, & Davids,
305 2014). In line with these ideas, physical literacy can, therefore, be seen as an emergent
306 property from interacting individual, task and environmental constraints (Seifert,
307 Button, & Davids 2013). However, given the dynamics and non-linearity of interacting
308 constraints, it is likely that a change in one category may lead to a change in emergent
309 movement behaviours (Clarke, 1995), resulting in changes in the way an individual
310 interacts with the environment. This characterisation allows us to conceptualise physical
311 literacy as a construct that changes and evolves over a lifespan.

312 The human body can move in many different ways, while at the same time,
313 being constrained by its structural organisation, enhancing (due to growth in size) or
314 limiting (due to aging, injury, disease) movement capabilities. From a dynamic systems
315 perspective, it is acknowledged that different systems might act as rate limiters for
316 different skills over different timescales (Thelen, 1998). For example, environmental
317 features offer different affordances for individuals as they are assessed in relation to the
318 individual, not according to an objective standard (Konczak, 1990). Our perception of
319 affordances changes as our capability for action changes; in other words, affordances
320 change as individuals change, and therefore the nature of our physical literacy changes.
321 This idea implies that environmental features are framed in terms of body scaling and

322 action capabilities over an individual's lifespan. For instance, a child might not be able
323 to climb a staircase structure of particular dimensions due to a mismatch between step
324 riser heights with the dimensions of his/her arms and legs at a specific state of
325 development (acting as a rate limiter). Until the child's growth, maturation and
326 development processes allow him/her to reach a critical ratio of leg length to step riser
327 height, the affordance of "*climbability*" of the structure by stepping is not perceived
328 (Warren, 1988). The nature, type and complexity of the settings change as certain
329 environmental affordances for action become more inviting (Withagen, Harjo, Araujo,
330 & Pepping, 2012). than others. Perception of affordances changes as capability for
331 action changes.

332 *Enhancing opportunities for individuals of all ages to interact with their environments*

333 One of the key features of learning design in physical education and sport, from an
334 ecological dynamics perspective, is to design 'in' affordances that can enhance the
335 opportunity for learners to develop stable functional perception-action couplings to
336 support performance (Chow et al., 2016). An important aspect of this, however, is the
337 need to 'match' the utility and meaning of the affordances designed into a learning
338 environment to the current action capabilities (known as effectivities in ecological
339 psychology) of the individual perceiving them (Woods et al., 2020). It is this design
340 feature that is likely to assist individuals to improve their perception-action coupling as
341 they are guided toward actualizing the most *soliciting* or inviting affordances within
342 their performance environment (Withagen et al., 2012). Importantly, these design
343 principles can extend beyond organised sports and physical education. In urban
344 planning and recreation, the designing in of rich and inviting opportunities for action
345 can support diverse and meaningful movement-based experiences for individuals at
346 varied stages of life. For instance, playgrounds have traditionally been synonymous

347 with young children, albeit having a little too much symmetry and risk aversion (Gill,
348 2007). However, Sales and colleagues (2017) argued for the benefits of designing
349 playgrounds for the elderly, where activity programmes, equipment and landscape are
350 deliberately designed (scaled) for action opportunities in seniors, according to their
351 effectivities (current intrinsic dynamics and capacities).

352 Recently, the UN World Population Prospects report (2019) revealed that the
353 global population of older adults is increasing at an unprecedented rate. Evidence points
354 to a positive association between older adults' physical activity and well-being (Nimrod
355 2011). Accordingly, aspects of urban designs could be re-configured (manipulation of
356 environmental constraints) to promote physical activity within older populations to
357 maintain their quality of life. Moreover, in a Guardian interview (2016), Stefano
358 Recalcati, a project leader behind the report 'Shaping Ageing Cities' explained that
359 cities must adjust if older people are to maintain quality of life, stating:

360 *"it's important to be conscious of the ageing trend. It is a huge challenge for*
361 *world cities – they will need to change, to make sure older people continue to*
362 *play an active role in the community and don't become isolated. Isolation has a*
363 *negative impact on health so tackling that is really important."*

364
365 From an ecological dynamics perspective, this issue needs to address accessibility.
366 Exploiting the 'invitational' nature of environmental affordances through deliberate
367 design, has the potential to offer different opportunities for action to increase (or
368 maintain) healthy behavior over a lifespan (Withagen & Caljouw, 2016). For instance,
369 the infamous and ubiquitous "No Ball Playing" signs in modern urban settings give a
370 clear signal to the population (especially children), actually inviting sedentary and
371 compliant lifestyles. Integrated policy making between politicians is needed in modern
372 town/city planning projects. For example, Anna Lind (2019), the Swedish Minister for
373 Sports, almost demanded an integrative policy making approach when querying town

374 planning policy from a child's rights perspective in the Swedish national newspaper
375 Dagens Nyheter (Johansson, 2020). She raised a question, when new homes are built,
376 that we all need to consider in other spheres of life: How often is the child's opportunity
377 to interact with the immediate environment (e.g. recreation areas) considered and
378 designed 'in' to the planning? To promote physical literacy through an ecological
379 dynamics framework, practitioners need to constantly consider and enhance
380 opportunities for individuals at all ages to interact with their environments. By doing so,
381 we may allow individuals the freedom to evolve their 'own' physical literacy, by
382 enhancing personal engagement through establishing an individual-environment fit.
383 Physical literacy involves self-regulation tendencies which can be guided and supported
384 by education and health-care professionals, but it is not the sole remit of these experts.

385 **Concluding Remarks**

386 The vagueness associated with the construct of physical literacy, as revealed in the
387 literature, elucidates a clear need for a comprehensive theoretical rationale to underpin
388 how to apply its concepts. We have argued, from an ecological dynamics perspective,
389 the concept of physical literacy can be enriched and extended in, and beyond, organised
390 sports and physical education, through the re-conceptualisation of an individual's
391 relationship with the specific environmental settings they interact with over a lifespan.
392 This ongoing and continuously developing relationship can be understood through the
393 assessment of available affordances for movement opportunities (expressed through
394 cognitions, perception and (inter)actions) in those specific settings (Flôres et al., 2019),
395 underpinned by how these contexts invite, permit or inhibit an individual-environment
396 fit (Bronfenbrenner, Ceci, 1993). Physical literacy can, therefore, be understood at the
397 level of the individual-environment system, where the dynamic and reciprocal

398 relationships between an individual and their environment can be developed and
399 analysed over time (Seifert, Orth, Button, Brymer, & Davids, 2017).

400

401 **References**

402 Addley, E. (2019, October 5). You could be Dina: teach children physical literacy, says
403 Sport England. *The Guardian*. Retrieved from

404 [https://www.theguardian.com/sport/2019/oct/05/physical-literacy-children-dina-asher-](https://www.theguardian.com/sport/2019/oct/05/physical-literacy-children-dina-asher-smith)
405 [smith](https://www.theguardian.com/sport/2019/oct/05/physical-literacy-children-dina-asher-smith)

406 Adolph, K. E. (2019). An Ecological Approach to Learning in (Not and) Development.
407 *Human Development*, 1-22.

408 Adolph, K. E., Hoch, J. E., & Cole, W. G. (2018). Development (of Walking): 15
409 Suggestions. *Trends in cognitive sciences*, 22(8), 699-711.

410 Adolph, K., & Kretch., K. (2015). Gibson's Theory of Perceptual Learning.

411 International Encyclopedia of the Social & Behavioral Sciences. 10. 10.1016/B978-0-
412 08-097086-8.23096-1.

413 Allan, V., Turnnidge, J., & Côté, J. (2017). Evaluating Approaches to Physical Literacy
414 Through the Lens of Positive Youth Development. *Quest*, 69(4), 515-530.

415 Almond, L. (2013). Physical literacy and fundamental movement skills: An introductory
416 critique. *Journal of Sport Science and Physical Education*, 65, 81–89.

417 Almond, L. (2014) Serious flaws in an FMS interpretation of physical literacy. *Science*
418 *and Sports*, 29, 60.

419 Araujo, D., & Davids, K. (2011). What Exactly is Acquired During Skill Acquisition?
420 *Journal of Consciousness Studies*, 18. 7-23.

421 Araújo, D., & Davids, K. (2009). Ecological approaches to cognition and action in sport
422 and exercise: Ask not only what you do, but where you do it. *International Journal of*
423 *Sport Psychology*, 40(1), 5–37.

424 Araújo, D., Davids, K., & Hristovski, R. (2006). The ecological dynamics of decision
425 making in sport. *Psychology of Sport and Exercise*, 7(6), 653-676.

426 Bernstein, N. (1967). *Co-ordination and regulation of movements*. Pergamon Press.

427 Bradley, R. H., & Corwyn, R. F. (2004). Life satisfaction among European American,
428 African American, Chinese American, Mexican American, and Dominican American
429 adolescents. *International Journal of Behavioral Development*, 28(5), 385–400.

430 Bronfenbrenner, U., & Ceci, S. J. (1993). Heredity, environment, and the question
431 “How?”: A first approximation. In R. Plomin & G. E. McClearn (Eds.), *Nature,*
432 *nurture & psychology*, 313–324. Washington, DC: American Psychological
433 Association.

434 Button, C., Seifert, L., Chow, J.-Y., Araújo, D., & Davids, K. (2020). Dynamics of Skill
435 Acquisition: An Ecological Dynamics rationale (2nd Edition). Champaign, Ill: Human
436 Kinetics.

437 Chow, J.-Y., Davids, K., Button, C., & Renshaw, I. (2016). Nonlinear pedagogy in skill
438 acquisition: an introduction. London. New York: Routledge.

439 Chow, J.-Y., Davids, K., Shuttleworth, R. & Araújo, D. (2020). Ecological dynamics
440 and transfer from practice to performance in sport. In *Skill Acquisition in Sport:*
441 *Research, Theory and Practice* (3rd Ed.) (Edited by A.M. Williams & N. Hodges), 330-
442 344. Routledge: London.

443 Clark, J. E. (1995). On Becoming Skillful: Patterns and Constraints. *Research Quarterly*
444 *for Exercise and Sport*, 66(3), 173–183.

445 Cools, W., De Martelaer, K., Samaey, C., & Andries, C. (2009). Movement skill
446 assessment of typically developing preschool children: A review of seven movement
447 skill assessment tools. *Journal of Sports Science & Medicine*, 8(2), 154.

448 Corbin, C. (2016). Implications of physical literacy for research and practice: A
449 commentary. *Research Quarterly for Exercise and Sport*, 87, 14–27.

450 Davids, K., & Araújo, D. (2010). The concept of 'Organismic Asymmetry' in sport
451 science. *Journal of science and medicine in sport*, 13(6), 633–640.

452 Davids, K., Araújo, D., Correia, V., & Vilar, L. (2013). How small-sided and
453 conditioned games enhance acquisition of movement and decision-making skills.
454 *Exercise and sport sciences reviews*, 41, 154-161

455 Davids, K., Araújo, D., Hristovski, R., Passos, P., & Chow, J. Y. (2012). *Ecological*
456 *dynamics and motor learning design in sport*. In N. J. Hodges & A. M. Williams (Eds.),
457 *Skill Acquisition in Sport: Research, Theory and Practice* (2nd ed., pp. 112-130).
458 London: Routledge

459 Davids, K., Araújo, D., Vilar, L., Renshaw, I., & Pinder, R. A. (2013). An ecological
460 dynamics approach to skill acquisition: Implications for development of talent in sport.
461 *Talent Development & Excellence*, 5, 21-34.

462 Dudley, D., Cairney, J., Wainwright, N., Kriellaars, D., & Mitchell, D. (2017). Critical
463 considerations for physical literacy policy in public health, recreation, sport, and
464 education agencies. *Quest*, 69(4), 436-452.

465 Dunwoody, P. T. (2006). The neglect of the environment by cognitive
466 psychology. *Journal of Theoretical and Philosophical Psychology*, 26(1-2), 139–153

467 Edelman, G. M., & Gally, J. A. (2001). Degeneracy and complexity in biological
468 systems. *Proceedings of the National Academy of Sciences of the United States of*
469 *America*, 98(24), 13763–13768.

470 Edwards, L. C., Bryant, A. S., Keegan, R. J., Morgan, K., & Jones, A. M. (2016).
471 Definitions, Foundations and Associations of Physical Literacy: A Systematic
472 Review. *Sports Medicine*, 47(1), 113–126.

473 Flay, B.R., & Petraitis J. (1994). The Theory of Triadic Influence: A New Theory of
474 Health Behavior With Implications for Preventive Interventions. *Advances in Medical*
475 *Sociology*, 4. 19-44.

476 Flôres, F. S., Rodrigues, L. P., Copetti, F., Lopes, F., & Cordovil, R. (2019).
477 Affordances for Motor Skill Development in Home, School, and Sport Environments: A
478 Narrative Review. *Perceptual and Motor Skills*, 126(3), 366–388.

479 Foulkes, J.D.; Foweather, L.; Fairclough, S.J.; Knowles, Z. “I Wasn’t Sure What It
480 Meant to Be Honest”—Formative Research Towards a Physical Literacy Intervention
481 for Preschoolers. *Children* 2020, 7, 76.

482 Gibson, E. J. (1978). C'est Moi [Review of the book *Insights from the blind:*
483 *Comparative studies of blind and sighted infants*, by S. Fraiberg & L.
484 Fraiberg]. *Contemporary Psychology*, 23(9), 609–611

485 Gibson, E. J. (1988). *Exploratory behavior in the development of perceiving, acting,*
486 *and the acquiring of knowledge.* In M. R. Rosenzweig & L. W. Porter (Eds.), *Annual*
487 *review of psychology. Annual review of psychology*, 39, 1–41.

488 Gibson, E. J. (1997). *An ecological psychologist's prolegomena for perceptual*
489 *development: A functional approach.* In C. Dent-Read & P. Zukow-Goldring
490 (Eds.), *Evolving explanations of development: Ecological approaches to organism–*
491 *environment systems*, 23–45.

492 Gibson, E. J., & Pick, A. D. (2000). *An ecological approach to perceptual learning and*
493 *development.* New York: Oxford University Press.

494 Gibson, J. J. (1966). *The senses considered as perceptual systems.* Boston, MA:
495 Houghton Mifflin.

496 Gibson, J. J. (1979). *The ecological approach to visual perception.* Boston, MA:
497 Houghton Mifflin.

498 Gill, T. (2007). *No fear: Growing up in a risk averse society*. London: Calouste
499 Gulbenkian Foundation.

500 Grahame, A. (2016, April 25). Improving with age? How city design is adapting to
501 older populations.. *The Guardian*. Retrieved from
502 [https://www.theguardian.com/cities/2016/apr/25/improving-with-age-how-city-design-](https://www.theguardian.com/cities/2016/apr/25/improving-with-age-how-city-design-is-adapting-to-older-populations)
503 [is-adapting-to-older-populations](https://www.theguardian.com/cities/2016/apr/25/improving-with-age-how-city-design-is-adapting-to-older-populations)

504 Guthold, R., Stevens, G.A., Riley, L.M., & Bull, F.C. (2018). Worldwide trends in
505 insufficient physical activity from 2001 to 2016: a pooled analysis of 358 population-
506 based surveys with 1.9 million participants. *The Lancet Global health*, 6 (10).

507 Headrick, J., Renshaw, I., Davids, K., Pinder, R.A., & Araújo, D. (2015). The dynamics
508 of expertise acquisition in sport: The role of affective learning design. *Psychology of*
509 *Sport & Exercise* 16, 83-90.

510 Hyndman, B., & Pill, S. (2018). What's in a concept? A Leximancer text mining
511 analysis of physical literacy across the inter- national literature. *European Physical*
512 *Education Review*, 24(3), 292–313.

513 International Physical Literacy Association (IPLA). (2017). Retrieved from
514 <https://www.physical-literacy.org.uk/>

515 Johansson, M. (2020, January 12). Amanda Lind: Idrotten har en hemläxa att göra.
516 *Dagens Nyheter*. Retrieved from [https://www.dn.se/sport/amanda-lind-idrotten-har-en-](https://www.dn.se/sport/amanda-lind-idrotten-har-en-hemlaxa-att-gora/#receipt-page)
517 [hemlaxa-att-gora/#receipt-page](https://www.dn.se/sport/amanda-lind-idrotten-har-en-hemlaxa-att-gora/#receipt-page)

518 Jurbala, P. (2015). What Is Physical Literacy, Really? *Quest*, 67(4), 367–383.

519 Kelso, Scott. (1995). Dynamic patterns: the self-organization of brain and behavior.
520 *Choice Reviews Online*, 33(03).

521 Konczak, J. (1990). Towards an Ecological Theory of Motor Development: The
522 Relevance of the Gibsonian Approach to Vision for Motor Development Research. New
523 York: Advances in Motor Development Research.

524 Kugler, P. N. (1986). A morphological perspective on the origin and evolution of
525 movement patterns. In M. G. Wade and H. T. A. Whiting (eds.), *Motor Development in*
526 *Children: Aspects of Coordination and Control*, 459-525.

527 Lundvall, S., & Tidén, A. (2013). Assessing embodied knowledge in Swedish PEH: the
528 influence of physical literacy. *International Council of Sport Science and Physical*
529 *Education Bulletin*, (65), 325–335.

530 Lynch, T. (2019). Global Policy: Holistic Health, Wellbeing and Physical Education
531 Evolution. In *Physical Education and Wellbeing* (pp. 43-58). Champaign: Palgrave
532 Macmillan.

533 McKenzie, T., & Lounsbury M. (2016). Physical literacy and the rose: What would
534 Shakespeare say? *Physical Activity Plan Alliance Commentaries on Physical Activity*
535 *and Health*, 2. Retrieved
536 from <http://www.physicalactivityplan.org/commentaries/McKenzie.html>

537 Moy, B., Renshaw, I., & Davids, K. (2014). Variations in acculturation and Australian
538 physical education teacher education students' receptiveness to an alternative
539 pedagogical approach to games teaching. *Physical Education and Sport Pedagogy* 19
540 (4), 349-369.

541 Moy, B., Renshaw, I., Davids, K., & Brymer, E. (2015). Overcoming acculturation:
542 Physical education recruits' experiences of an alternative pedagogical approach to
543 games teaching. *Physical Education and Sport Pedagogy*, 21, 386–406.

544 Newell, K.M. (1986). Constraints on the Development of Coordination. In *Motor*
545 *Development in Children: Aspects of Coordination and Control*, 341–360. Amsterdam:
546 Springer Science and Business Media.

547 Ng, J., & Button, C. (2018). Reconsidering the fundamental movement skills construct:
548 Implications for assessment. *Movement and Sports Sciences*, 4, 19-29.

549 Nimrod, G. (2011). The Impact of Leisure Activity and Innovation on the Well Being of
550 the Very Old. In L. Poon & J. Cohen-Mansfield (Eds), *Understanding Well-Being in the*
551 *Oldest Old* (pp. 240–257). Cambridge: Cambridge University Press.

552 Renshaw, I., & Chow, J.-Y. (2018). A Constraint-Led Approach to Sport and Physical
553 Education Pedagogy. *Physical Education and Sport Pedagogy*, 24(2), 103–116.

554 Renshaw, I., Oldham, A. R., & Bawden. M. (2012). Nonlinear pedagogy underpins
555 intrinsic motivation in sports coaching. *The Open Sports Sciences Journal*, 5, 88-99.

556 Rietveld, E., & Kiverstein, J. (2014). A Rich Landscape of Affordances. *Ecological*
557 *Psychology*, 26(4), 325-352.

558 Roberts, W. M., Newcombe, D. J., & Davids, K. (2018). Application of a Constraints-
559 Led Approach to pedagogy in schools: embarking on a journey to nurture Physical
560 Literacy in primary physical education. *Physical Education and Sport Pedagogy*, 24(2),
561 162–175.

562 Ross, E., Gupta, L., & Sanders, L. (2018). When research leads to learning, but not
563 action in high performance sport. *Progress in brain research*, 240, 201–217.

564 Rudd, J. R., O' Callaghan, L., and Williams, J. (2019). Physical Education Pedagogies
565 Built upon Theories of Movement Learning: How Can Environmental Constraints Be
566 Manipulated to Improve Children's Executive Function and Self-Regulation Skills?
567 *International Journal of Environmental Research and Public Health* 16.

568 Rudd, J. R., Crotti, M., Fitton-Davies, K., O’Callaghan, L., Bardid, F., Utesch, T., ...
569 Foweather, L. (2020). Skill Acquisition Methods Fostering Physical Literacy in Early-
570 Physical Education (SAMPLE-PE): Rationale and Study Protocol for a Cluster
571 Randomized Controlled Trial in 5–6-Year-Old Children From Deprived Areas of North
572 West England. *Frontiers in Psychology*, *11*, 1228.

573 Rudd, J. R., Pesce, C., Strafford, B, Davids, K (In Press) Physical Literacy, a journey of
574 individual enrichment: an Ecological Dynamics rationale for enhancing performance
575 and physical activity in all. *Frontiers in Psychology*

576 Sales, M., Polman, R., Hill, K. D., & Lvinger, P. (2017). A Novel Exercise Initiative
577 for Seniors to Improve Balance and Physical Function. *Journal of Aging and*
578 *Health*, *29*(8), 1424–1443.

579 Seifert, L., Button, C., & Davids, K. (2013). Key Properties of Expert Movement
580 Systems in Sport. *Sports Medicine* *43*(3), 167–178.

581 Seifert, L., Orth, D., Button, C., Brymer, E., & Davids, K. (2017). An Ecological
582 Dynamics Framework for the Acquisition of Perceptual–Motor Skills in Climbing.
583 *Extreme Sports Medicine*, 365-382.

584 Shearer, C., Goss, H. R., Edwards, L. C., Keegan, R. J., Knowles, Z. R., Boddy, L. M.,
585 & Foweather, L. (2018). How is physical literacy defined? A contemporary update.
586 *Journal of Teaching in Physical Education*, *37*(3), 237–245.

587 Spengler, J. O., & Cohen, J. (2015). Physical literacy: A global environmental
588 scan. Washington, DC: The Aspen Institute.

589 Sport Australia (2019). The Australian Physical Literacy Framework. Retrieved from
590 [https://www.pescholar.com/wp-content/uploads/2019/08/The-Australian-Physical-](https://www.pescholar.com/wp-content/uploads/2019/08/The-Australian-Physical-Literacy-Framework.pdf)
591 [Literacy-Framework.pdf](https://www.pescholar.com/wp-content/uploads/2019/08/The-Australian-Physical-Literacy-Framework.pdf)

592 Sport England (2016). Towards an Active Nation. Strategy 2016-2021. Retrieved from
593 [https://sportengland-production-files.s3.eu-west-2.amazonaws.com/s3fs-public/sport-
594 england-towards-an-active-nation.pdf](https://sportengland-production-files.s3.eu-west-2.amazonaws.com/s3fs-public/sport-
594 england-towards-an-active-nation.pdf)
595 Thelen, E. (1998). Bernstein's legacy for motor development: How infants learn to
596 reach. In M. Latash (Ed.), *Progress in Motor Control* (pp. 267-288). Champaign, IL:
597 Human Kinetics.
598 Tremblay, M., & Lloyd, M. (2010). Physical literacy measurement—the missing piece.
599 *Physical and Health Education Journal*, 76(1), 26–30.
600 UNICEF. (2007). Child poverty in perspective: An overview of child well-being in rich
601 countries—A comprehensive assessment of the lives and well-being of children and
602 adolescents in the economically advanced nations. Innocenti Research Centre Report
603 Card 7 C. Florence: The United Nations Children's Fund. Retrieved from [https://unicef-
604 irc.org/404.html?request=/publications/pdf/rc7_eng.pdf](https://unicef-
604 irc.org/404.html?request=/publications/pdf/rc7_eng.pdf)
605 Uehara, L., Button, C., Falcous, M., & Davids, K. (2014). Contextualised skill
606 acquisition research: a new framework to study the development of sport
607 expertise. *Physical Education and Sport Pedagogy*, 21(2), 153–168.
608 United Nations. (2019) Department of Economic and Social Affairs (2019). Retrieved
609 from <https://population.un.org/wpp/>
610 van Dijk, L., & Rietveld, E. (2017). Foregrounding Sociomaterial Practice in Our
611 Understanding of Affordances: The Skilled Intentionality Framework. *Frontiers in*
612 *psychology*, 7, 1969.
613 Warren, W.H. (1988) Action modes and laws of control for the visual guidance of
614 action. In O. Meijer & K. Roth (Eds.), *Movement behavior: The motor-action*
615 *controversy*. Amsterdam: North Holland

616 Warren, W. H. (2006). The dynamics of perception and action. *Psychological Review*,
617 113(2), 358-389.

618 Way, R., Balyi, I., Trono, C., Harber, V., & Jurbala, P. (2014). Canadian Sport for Life-
619 Long-term athlete development resource paper 2.0. Vancouver: Canadian Sport
620 Institute-Pacific.

621 Webster, E. K., & Ulrich, D. A. (2017). Evaluation of the psychometric properties of
622 the Test of Gross Motor Development—third edition. *Journal of Motor Learning and*
623 *Development*, 5(1), 45-58.

624 Whitehead, M. (2001). The concept of physical literacy. *European Journal of Physical*
625 *Education*, 6(2), 127–138.

626 Whitehead, M. (2007). Physical Literacy: Philosophical Considerations in Relation to
627 Developing a Sense of Self, Universality and Propositional Knowledge. *Sport, Ethics*
628 *and Philosophy*, 1(3), 281–298.

629 Whitehead, M. (2010). *Physical literacy: Throughout the life course*. London:
630 Routledge.

631 Whitehead M. (2013). Definition of physical literacy and clarification of related issues.
632 *International Council of Sport Science and Physical Education Bulletin*, 65, 28–33.

633 Whitehead, M. And Murdoch, E. (2006) Physical Literacy and Physical Education:
634 Conceptual Mapping, *Physical Education Matters*, 1(1), 6-9

635 Withagen, R., Harjo, D. P., Araujo, D., & Pepping, G.-J. (2012). Affordances can invite
636 behavior: Reconsidering the relationship between affordances and agency. *New Ideas in*
637 *Psychology*. 30. 250-258.

638 Withagen, R., & Caljouw, S. R. (2016). ‘The end of sitting’: An empirical study on
639 working in an office of the future. *Sports Medicine*, 46(7), 1019–1027.

640 Woods C.T., McKeown, I., Rothwell, M., Araújo, D., Robertson, S., Davids, K. (2020).
 641 Sport Practitioners as Sport Ecology Designers: How Ecological Dynamics Has
 642 Progressively Changed Perceptions of Skill ‘Acquisition’ in the Sporting Habitat.
 643 *Frontiers in Psychology*, 11.
 644 Young, L., O’Connor, J., & Alfrey, L. (2019). Physical Literacy: a Concept Analysis.
 645 *Sport, Education and Society*, 1–14.
 646
 647
 648 <Table 1>

<i>Whitehead 2001 Physical Literacy Definition</i>	<i>Ecological Dynamics Rationale.</i>
<i>Line 1: A physically literate individual moves with poise, economy and confidence in a wide variety of physically challenging situations.</i>	To move with <i>poise, economy and confidence</i> is predicated on an individual’s functional and structural capacities, such as their prior movement experiences, their motivational and emotional states (Headrick et al., 2015) and their cognitive self-regulation skills (Rudd et al., 2019). These interact with the physics and structural features of the environment as well as the individual’s specific intentions during an activity or task (Davids et al., 2013). A physically literate child playing a game in a playground or formal sport setting has ‘skilled intentionality’ if he/she is able to adapt to a range of <i>challenging situations</i> that emerge from the interacting performance constraints in order to functionally achieve a successful outcome during the activity (Chow et al., 2016).
<i>Line 2: the individual is perceptive in ‘reading’ all aspects of the physical environment, anticipating movement needs or possibilities and responding appropriately to these, with intelligence and imagination.</i>	A physically literate child is able to <i>read</i> an environment through exposure to a range of varied task constraints, and he/she progressively becomes attuned to the relevant affordances (invitations for action) within his/her environment. This attunement process is predicated on the perception of information to regulate actions, which helps children adapt movements to exploit key constraints to functionally achieve a task goal (Araujo & Davids, 2009). <i>...Responding appropriately to these emergent task constraints, with intelligence and imagination</i> is similar to the idea of ‘dexterity’ put forward by Bernstein (1967). He

argued that dexterity is the ability to find a movement solution for any external situation, to adequately solve any emerging movement problem arising from the changing nature of environmental and tasks constraints.

Line 3: Physical literacy requires a holistic engagement that encompasses physical capacities embedded in perception, experience, memory, anticipation and decision making'

Ecological dynamics is a theoretical framework that seeks to understand human behaviours such as performance and learning at the individual-environment scale of analysis, as they interact to form the individual-environment system. From an Ecological Dynamics perspective, learners are regarded as complex adaptive systems, seeking opportunities for action (affordances) from their environment. The concept of affordances highlights the continuous and *holistic* interactions between the environmental features and *embedded* functional capabilities of the individual.