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1 **Can't jump, won't jump: Affordances of the horse-rider dyad underpin skill adaptation**
2 **in Showjumping using a constraints-led approach.**

3
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10 Conflict of Interest: Marianne Davies, Joseph A. Stone, Keith Davids, Jane Williams & Mark
11 O'Sullivan declare that they have no conflict of interest.

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32 **Keywords:** Agency, affordances, co-adaptation, perception-action coupling, equestrian
33 coaching, complex system

35 **Abstract**

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Equestrianism is part of a global industry influenced by a rich history of over 4000 years of culture and tradition. As the only interspecies Olympic event, equestrianism is facing negative public perceptions of competition performance and traditional coaching practices. In this position paper we propose a constraints-led approach (CLA) as a framework for contemporising equestrian coaching practice. Ecological dynamics is the theoretical framework that underpins a CLA methodology, providing guiding principles that inform a nonlinear pedagogy in sport and physical education. A CLA focusses on the individual (organism/s), task and environmental constraints acting over multiple nested timescales and what this means for how behaviour emerges. Using examples from the equestrian discipline of showjumping, we outline how a CLA can inform coaching behaviour and practice design to support skill acquisition through co-adaptations in the horse-rider dyad system. By focussing on the horse-rider dyad as a complex system, there is a move away from a human-centric perspective of compliance and control of the horse, toward system agency and intentionality in problem solving. Practice design principles of intention, representativeness, constraints manipulation and functional variability support the dyad to co-adapt and interact effectively through practice to achieve performance goals. Skilful performance is developed through attunement to perceptual information that invites opportunities for action (affordances). Understanding the development of *affordance* perception in the horse-rider dyad could guide the application of a constraints-led approach to equestrian coaching practice.

64 1.0 Introduction

65 Equestrianism is part of a global industry with an estimated economic impact of \$300
66 billion per annum. Despite including three Olympic disciplines, as well as a higher proportion
67 of disabled, female, and over 45-year-old participants than any other sport [1], there is little
68 published research currently exploring pedagogy and coaching practice in equestrian sports
69 and activities. A significant characteristic of equestrianism is the performance partnership
70 between a horse and a human: a complex adaptive system formed by two animate
71 components with different perceptual, motivational, and communication characteristics [2-3].

72 Successful equestrian performance has been described as highly embodied, and
73 synchronous, capturing aspirations of riders to become *centaur-like* in their relationship with
74 their horses [4-6]. Indeed, ethnographic accounts of riders capture experiences of co-being,
75 co-creating behaviour and a sensation of feeling ‘part of the animal’ [5,7]. Further, skilful
76 performance has been described using metaphors from music (e.g., rhythmic harmonisation,
77 accentuation) [4,7]. Despite these insights alluding to collaborative partnerships, traditional
78 approaches to training and coaching in equestrianism emphasise a hierarchical relationship
79 between rider and horse, typically characterised by methods demanding equine compliance
80 and obedience [8-9]. Increasingly, animal rights groups [10] frame equestrianism as
81 inherently abusive in nature, primarily due to lack of agency of the horse [11]. For example,
82 Hall et al.’s [12] review on equine learned helplessness concluded that, *‘there is little doubt*
83 *that the techniques and devices used in the training and riding/ driving of horses, as well as*
84 *during their management, have the potential to place horses in a situation where they could*
85 *develop this phenomenon’* (p.263).

86 In this position piece we examine how a contemporary approach to skill adaptation
87 [13] has the potential to develop performance competency, while also addressing some
88 current challenges facing equestrianism. Focusing on showjumping, we examine current

89 underpinning theories before outlining how ecological dynamics could provide a theoretical
90 framework for understanding performance enhancement in the horse-rider dyad system. We
91 embrace principles of a nonlinear pedagogy [14] as an alternative for supporting skill
92 adaptation through the use of a CLA in coaching and practice design. Finally, we highlight
93 future research areas that warrant further investigation.

94

95 **2.0 Theoretical underpinnings of traditional practice in equestrianism**

96 Traditional training and coaching methodologies are underpinned by two main
97 theories of performance, cognition and learning with incompatible ontological roots [15-16].
98 Firstly, behaviourist theories from the late 1800s and early 1900s focus on learning being
99 formed outside of the individual through external reinforcement and rote repetition [17].
100 Behaviourism underpins traditional instructional practice of humans [17] and the training of
101 all animals, including horses [18]. Promoting the notion that learning is a passive process,
102 based on conditioned responses to environmental stimuli, behaviourism ignores the
103 organisms' agency in learning experiences. Behaviourism is still the main underpinning
104 theoretic framework used for training the horse through reward, reinforcement, and
105 punishment to recognise and obey commands issued by the rider [19-20]. As Blokhuis and
106 Lundgren [p4] emphasise '*horses are seen more as objects responding to humans' initiatives*
107 *that subjects interacting with humans'* [21]. Secondly, supporting the coaching of riders,
108 current UK coaching qualifications espouse both behaviourist (framed as coach-led) and
109 constructivist (framed as student-led) informed coaching styles [22]. Constructivism posits
110 that learning is an active process constructed in the mind of the individual in response to their
111 experiences, separating the organism and environment during interactions [16]. However,
112 particularly with novice riders, coaching behaviour typically comprises a coach stood on the
113 ground providing explicit instructions based on 'optimal' techniques and what the coach

114 believes the rider needs to do to improve performance [17]. This learning approach results in
115 the rider being passive, rather than active, in knowledge construction [22].

116 In conjunction with other sports, training methods have become dominated by an
117 inherent focus on error correcting toward idealised form and technique [13, 23]. This is likely
118 a result of coaching pedagogy and qualifications predicated on behaviourist and/or
119 constructivist learning theories, combined with information processing theories of skill
120 acquisition that focus on attaining ‘correct’ movement techniques [23]. In equestrianism, an
121 unintended consequence may be the use of the use of controlling and restrictive training aids
122 and gadgets in practice (for example draw reins and severe bits). While research has led to
123 some positive changes to competition rules [24-25], many banned practices prevail outside
124 competition due to beliefs about how horses learn to become skilful. In summary, a lack of a
125 coherent, contemporary theoretical framework for understanding learning and skill adaptation
126 in both organisms, combined with a human-centric perspective, underlie traditional ideas and
127 coaching pedagogies underpinning practices in equestrianism.

128 129 **3.0 Ecological dynamics and nonlinear pedagogy: A contemporary framework for using** 130 **a constraints-led approach for coaching in equestrianism**

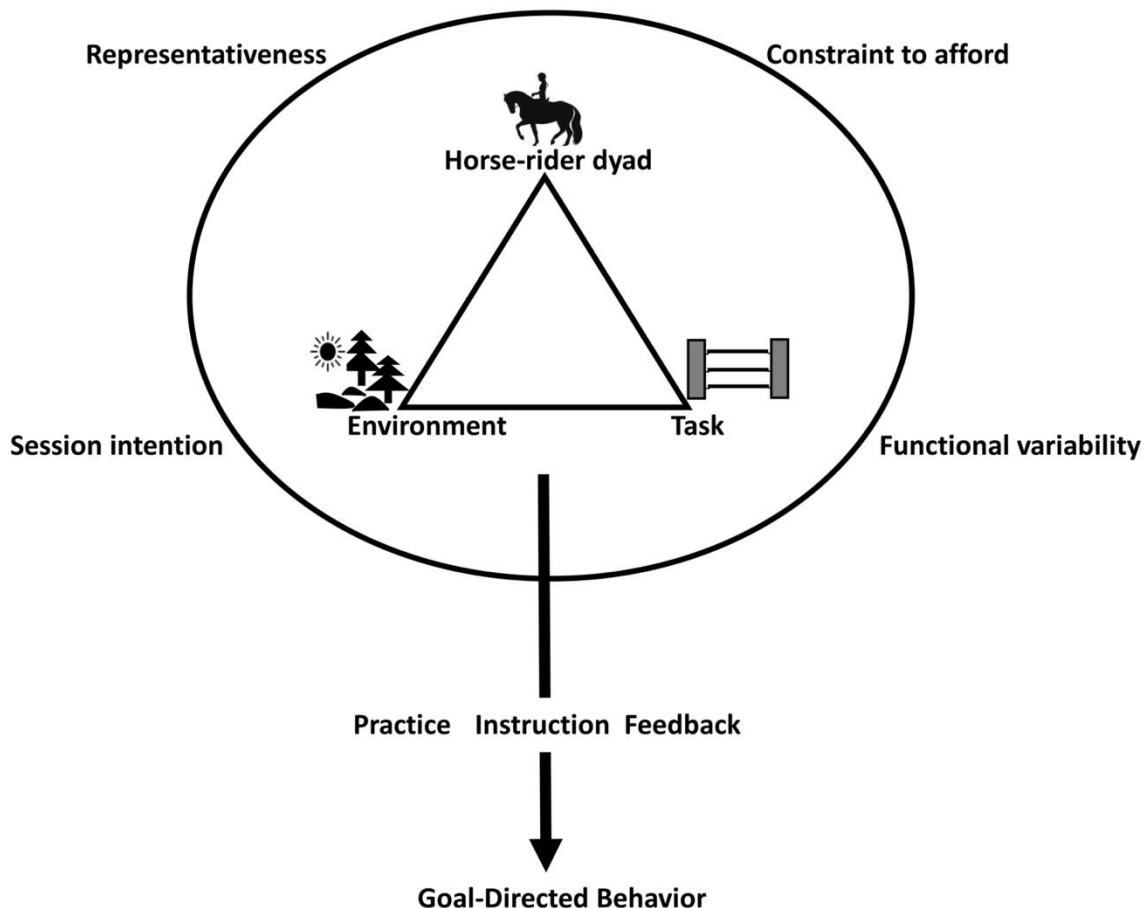
131 To negate the issues outlined in section two, we propose ecological dynamics as a
132 framework for understanding skill adaptation in equestrian practice, which provides a fusion
133 of ecological psychology and dynamical systems theory [26, 27]. Ecological psychology [28]
134 avoids an *organismic asymmetry* (favouring internalised, mental explanations for behaviour
135 localised within the brain of an organism) [29]. Rather, it proposes that all organisms have
136 evolved to perceive and progressively develop sensitivity to surrounding information in their
137 environment that informs the continuous regulation of their behavioural interactions [30, 31].
138 Opportunities available to the organism inviting actions and interactions within the
139 environment (termed *affordances*), emphasise the meaning of the environment for the

140 organism, and the value of the information for facilitating goal directed movement [32]. The
141 process of becoming skilfully attuned to perceptual information that supports such
142 opportunities for action results in tighter coupling of perception and action sub-systems with
143 practice [33]. From an ecological perspective, an organism's interactions with its
144 environment are conceived as the appropriate scale of analysis for understanding behaviour,
145 due to the inextricably entwined nature of cognitions, perception, and action.

146 Originating in mathematics with notable early applications to weather
147 forecasting, ecology [34], and later to quadruped coordination dynamics and gait transitions
148 [35], dynamical systems theory explains coordination behaviours in complex adaptive
149 systems, such as horses and humans. The horse-rider dyad, considered as a bio-tensegrity
150 system, is an example of a haptically-coupled (emphasizing information from compression,
151 touch and pressure), complex dynamical system [37, 38]. Bio-tensegrity systems, like horse-
152 rider dyads, maintain stability through a balance of pre-compression and tension, allowing the
153 perception and communication of pressure and touch through the distortion of the pre-
154 tensioned structures such as muscles, bones, fascia, ligaments, tendons and even cell
155 membranes [37].

156 Ecological psychology provides a theoretical explanation for understanding the
157 integration of perception, action, decision making and cognition. Dynamical systems theory
158 seeks to explain how movement organisation, adaptation and control emerges from a
159 complex adaptive system with many degrees of freedom that need to be (re)organised (e.g.,
160 muscles, limbs, joints, fascia, neurons) [39]. Ecological dynamicists rationalise how complex
161 systems interact with challenging performance environments by coupling movement to
162 perceptual information, exploiting intentions and harnessing cognition, to make decisions,
163 solve problems and coordinate functional behaviours [26].

164 In nonlinear pedagogy, the focus of coaching moves away from the notion of
 165 training of idealised, ‘putatively correct’ techniques with linear progressions [23]. Instead, the
 166 guiding principles of nonlinear pedagogy support coaches and support staff in becoming
 167 *practice activity designers* [14], acknowledging that behaviours of horses and riders need to
 168 be considered in horse-rider dyads, continuously influenced by multiple interacting
 169 constraints. This perspective recognises the nonlinearity of emergent skilful behaviours in
 170 adaptation to a performance environment. Coaches and support staff can use a CLA to
 171 facilitate the co-adaptation of the horse-human dyad in the process of becoming an integrated,
 172 skilful system (see Fig 1).



173 **Fig 1. A constraints-led approach for skill acquisition in the horse-rider dyad.**
 174 Using the practice design principles of intentionality, representativeness, constraints manipulation, and
 175 functional variability, the horse-rider dyad system becomes attuned to shared affordances in realising goal
 176 directed behaviours.
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179 **3.1 The horse-rider dyadic system**

180 Supporting ethnographic accounts of embodied *centaur-like* experiences [7], research
181 examining horse-rider performance has repeatedly shown that experienced riders are
182 biomechanically coupled and synchronous (in-phase) with the movements of their horses [41-
183 43]. These studies postulate that skilled riders coordinate and couple their movements with
184 the horse through their capacity to anticipate, attune to, and use, perceptual information from
185 their continuous interactions as a dyad [44, 45]. The co-adaptation of the horse and rider is
186 hypothesised to be integral to both learning and performance, learning from each other as
187 they become attuned to the affordances available to the horse-rider dyad as an informationally
188 coupled system.

189 Phenomenology has been used as a method to focus on the lived experiences of the
190 rider and horse in their interspecies relationship during riding [46, 47, 48]. Phenomenological
191 research highlights that rider perceptions are not those of mastery over, but reciprocity of
192 learning and ‘becoming one with the horse’ [48, 49]. The notion of ‘becoming one’ aligns
193 well with an ecological dynamics perspective of the dyad functioning as a single complex
194 adaptive system, in which both components need to become attuned to surrounding
195 information and shared affordances in performance. Maustrad et al. [5, p326] assert that
196 horse-human communication ‘*crosses the species divide through somatic attunements and*
197 *attentions that are partly about uncovering and discovering what bodies do, and partly about*
198 *taking control of them, creating and making sense of body kinetics*’. Pressure from touch as a
199 channel of interspecies communication through haptic perception to continuously regulate co-
200 adaptive actions may provide a theoretical explanation for the elusive concept of ‘feel’ in
201 equestrianism. Ecological dynamics proposes that intentionality and emotions in the dyadic
202 system can be channelled through haptic information [37]. For example, haptic information
203 can inform the horse of a rider’s intentions, such as to turn left or speed up. Riders can learn
204 to feel a horse’s emotions and intentions in jumping over a barrier.

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4.0 Using the practice design principles of a constraints-led approach for coaching

showjumping

Showjumping competitions comprise a set course of knock-down jumps of specified dimensions, with specific rules about distances, speed, course time limits and number of rounds [50]. With practice and experience, the two separate animate systems (horse and rider) need to become attuned to critical information sources that have value and meaning for perceiving affordances (opportunities for action) such as ‘jump-ability’ and ‘time-to-contact’ with a fence. Some information sources which the horse-rider dyadic system becomes attuned to with practice when approaching a jump, include: surface terrain and incline, obstacle shape, orientation, height, appropriate take-off distances, speed and stride length approaching the obstacle, and probability of success [51]. In the following sections we will expand on the four practice design principles of a constraints-led approach.

4.1 Session intention

Nonlinear pedagogy informs the design of practice activities that are meaningful in terms of the rider’s goals, realised through horse-rider dyadic interactions with movement challenges and problems. The horse-rider dyad engages in problem solving through attending to shared goals, affordances and specifying information. To achieve this aim, the performance of the dyadic system in performance and practice should be based on making decisions and calibrating actions, rather than just passively responding to coach instructions [14]. Manipulating constraints of practice environments is a key to enrich the performance of the dyadic system [52].

229 **4.2 Constraints manipulation: supporting self-organisation**

230 Constraints are informational sources that act as boundaries, shaping performance
231 over multiple nested timescales [52]. Categorised as organismic, task and environmental,
232 constraints shape or guide the (re)organisation of behaviour in complex systems [583]. In
233 showjumping there is a rich tradition of using task constraints such as positioning poles to
234 create ground lines, fillers, grids (lines of jumps) [54], and equipment use, such as draw reins,
235 side reins and martingales to constrain horse movements. *However, using constraints in this*
236 *way is not always the same as using a constraints-led approach to facilitate horse-dyad*
237 *learning interactions.* A CLA is a theoretically informed methodology for designing practice
238 activities, using principles of a nonlinear pedagogy, predicated on key concepts in ecological
239 dynamics [52]. By manipulating constraints, coaches seek to design practice activities that
240 dampen affordances for movement solutions that are less functional and amplify affordances
241 that are more functional, without prescribing movement solutions [23].

242 Using poles on the ground to facilitate a horse to adapt stride length and speed when
243 navigating obstacles different distances apart would be aligned with principles of a CLA.
244 However, using poles to dictate exactly where a horse can take off over a jump would not be,
245 because the horse is entrained to the information from the poles to calibrate the approach
246 phase. The horse-rider system is no longer able to explore, calibrate, learn and adapt, using
247 multiple sources of information. Examples of effective constraints used in showjumping
248 include building courses with shorter related distances between the jumps to encourage a
249 short and bouncy more powerful canter, or putting up poles in a cross shape or at the sides of
250 a jump to invite a straight jump [54]. Essentially constraints manipulation needs to support
251 information movement coupling. Practices such as rapping, used to condition horses to make
252 an idealised forelimb shape and be more ‘careful’, following punishment or a perceived
253 increase of proprioception, continue because they are believed to be effective. However, an

254 ecological perspective suggests that these practices are likely to increase the risk of learned
255 helplessness and compromise the development of information-movement coupling in horses
256 [33]. Rather than supporting long-term skill adaptation, the horse will learn that it cannot trust
257 the perceptual information offered by a jump, despite any actions it decides to take.

258

259 **4.3 Representativeness**

260 Each level of Showjumping competition has shared rules and characteristics,
261 including maximum jump heights, related and overall distances, course complexity, and time
262 allowed [50]. Instead of de-contextualising practice, a CLA encourages use of practice
263 activities that are representative of competition demands. These include such things as
264 jumping on multiple surfaces, with an audience, background noise and other distractions, in
265 addition to task manipulations such as changing jump combinations, and variations of speed,
266 stride length and approach angles [54]. This does not mean that practice needs to always
267 simulate full competition conditions. Rather, the information that specifies movement
268 (re)organisation in competition needs to be present in practice sessions.

269 The importance of self-organisation and the need for adaptability have been
270 highlighted in many sports involving a run up to a target [55]. Research in long-jump
271 elucidates the individuality of gait regulation distributed across run-ups, particularly in
272 relation to environmental constraints such as wind strength and direction [56]. Key findings
273 note that run-ups cannot be split into distinct phases, and take-off is not just a position of a
274 foot fall, but the orientation of the whole body such that it can be propelled upward and
275 forward [57]. The implications of this information for equine showjumping practice would be
276 to design training activities that are high in context-specificity such as jump specifications,
277 speed over the ground, distance between jumps, number of jumps, and course length. This

278 representativeness provides the horse-rider system opportunities to search for, explore and
279 exploit key information for calibrating gait adaptations to take-off.

280

281 **4.4 Functional Variability**

282 Functional variability relates to the principle of repetition of outcome without
283 repetition of solution. Research in springboard diving [58] highlighted the negative
284 implications of practising only perfect run-ups (hurdle steps). In competition, divers can incur
285 penalties if unable to adapt to imperfect run-ups, lacking the ability to recover from
286 perturbations. In showjumping, this practice design might include varying starting positions,
287 lines, rhythms, speed, and angles once a stable outcome becomes established, then varying
288 task and environmental constraints such as jump types, weather, light, inclines, and surfaces
289 without prescribing idealised movement biomechanics.

290

291 **5.0: Focus on affordance perception: *Can't jump, won't jump.***

292 Language is powerful in creating and maintaining cultural norms, practices, and
293 behaviours [59]. In the United Kingdom, problematic and deeply enculturated language is
294 used to describe horses as well as our interactions and relationships with them. For example,
295 horses are regularly described as being 'honest', 'naughty', 'lazy', 'bombproof', needing to
296 be 'squared-up', 'kicked-on', or 'taught some respect'. An 'honest horse' is a horse that is
297 obedient to commands or cues and will jump when demanded, even if the rider has made an
298 error, or if the horse does not perceive an affordance to jump that a rider does. Incidences
299 such as the eventing horse Raphael jumping into a clearly unjumpable barrier during the Pau
300 CCI5* in 2019 [60], highlight the potential dangers of training a horse to trust or fear the
301 rider, rather than utilising their own perceived affordances to jump successfully.

302 An important change would be to move away from punishing horses for stopping or
303 running out at jumps, toward designing more sophisticated jumping practice environments.
304 Practice needs to support the education of the horse *and* rider's systemic intentions, attention,
305 and (re)calibration of information perception and movement. By forcing the horse to choose
306 between jumping or being punished, to obey cues from a rider instead of acting on perceived
307 affordances through specifying information, there is a failure to consider that the horse is an
308 organism that has evolved with acute direct perception of relevant information for action
309 from its environment, related to its internal dynamics and action capabilities. By attempting
310 to thwart the horse's affordance realisation, the rider is over-riding system functionality
311 through attunement to shared affordances that harness the horse's action-capabilities

312 In summary, if horse-rider systems need to move with intentionality to become skilful,
313 there is a necessity for both components to be able to calibrate to the challenge of negotiating
314 different obstacles over different surfaces and inclines in different environmental conditions.
315 Practice designs in equestrianism requires the provision of opportunities for the dyadic
316 system to engage in, and solve, movement problems and challenges. Movement problems in
317 practice need to be representative of competitive performance goals, to have meaning and
318 value. Above all, practice designs should aim to facilitate adaptability and (re)calibration of
319 perception and action in the horse-rider system. Coach and rider expectations may require a
320 re-evaluation of what may be misconceived horse 'disobedience', potentially due to a rider's
321 inaccurate or badly timed cues, based on poor perception and misuse of affordances. A major
322 aim of practice in equestrianism is to facilitate skilled intentionality and perception-action
323 coupling in the horse-rider system (will jump, can jump!).

324

325 **5.0 Conclusion and further research directions**

326 In this paper we proposed an ecological dynamics rationale for skill adaptation as a
327 way forward in contemporising equestrian coaching practice. From this perspective,
328 becoming skilful is a process of attuning to emerging affordances for action available within
329 a performance landscape shaped by individual organismic, task and environmental
330 constraints. Through self-directed intentional interactions with these affordances, changes in
331 action capabilities (coordination and capacity) invite the possibility of further affordances
332 [57]. An ecological conceptualisation of skill adaptation suggests a need to shift the role of
333 coaches and support staff from being solution providers to learning environment designers,
334 using constraints manipulation to support perception-action coupling and attunement to
335 affordances offered within organism-environment interactions [55].

336 Effective and sophisticated practice design in showjumping requires an understanding
337 of the performance demands and the shared affordances that skilled showjumping dyads need
338 to become attuned to for successful performance [61]. These affordances are likely to be a
339 mixture of opportunities offered both ‘to’ and ‘by’ the horse as part of the embodied dyadic
340 partnership, and affordances for goal achievement developed through experience of shared
341 system affordances, such as time-to-contact and jumpability.

342 Further research is needed to understand the implications and effectiveness of
343 adopting a CLA in equestrian sports along with the challenges and opportunities that coaches
344 are likely to face. Other potential areas of research include attempting to identify the
345 specifying information sources that are used as affordances for jumping by horses and the
346 range of coordination strategies for calibration of movement toward affordance realisation,
347 with and without riders. Research in these areas would support coaching and training practice
348 and, potentially the design of safer jumping courses.

349 Finally, further research is needed to understand how the dyadic horse-rider system
350 can reconcile the need for agency of both partners whilst still ensuring both human and
351 equine safety. To achieve this aim, there is a need for the human partner in the dyadic system
352 to become a better haptic communicator, enhancing their attunement to the horse's needs and
353 affordance perception.
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