Social Environment in Pacing and Sports Performance

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Pacing has been described as a goal-directed process of decision making in which athletes decide when and how to distribute their limited energy resources throughout an exercise task. Adequate pacing behaviour is critical in sports as it facilitates optimal performance. In sports settings, numerous lab and field studies consistently revealed that the social environment is an influential factor in athletes' pacing and performance, as first observed by Triplett. In head-to-head sports, such as cycling, running, and speed skating, opponents can act as social placebos, inviting changes in athletes' pacing behaviour impacting positively on performance, while their rate of perceived exertion remains the same. According to the ecological perspective, this occurs because opponents act as social affordances (invitations for actions), providing the athlete with additional performance feedback and therefore influencing their decision-making.

metacognition self-control motivation coaches opponents

1. The Cyclical Model of Self-Regulation of Learning (SRL)

The Cyclical Model of SRL describes the interrelation between the cognitive, metacognitive, and motivational mechanisms in three self-regulatory phases: forethought, performance, and self-reflection [1]. The forethought phase consists of task analysis and self-motivation processes [1]. Task analysis involves two parts: setting goals (the outcomes that an individual wants to attain) and strategic planning (choosing learning methods that are appropriate for the task). The forethought phase is influenced by different sources of self-motivation, such as outcome expectations (believed consequences of an individual's behaviour), goal orientation (reasons for engaging in specific behaviours), intrinsic interest/intrinsic motivation (the individual's liking or disliking of an activity due to intrinsic motives) and self-efficacy (individual's beliefs in their abilities to think and act towards their learning goals) [2][3].

The performance phase follows the forethought phase and is composed of self-control and self-observation methods [1]. Individuals use a variety of strategies to attain self-control such as imagery (forming mental pictures to facilitate the learning process), help-seeking (providing assistance when an individual performs an activity) and self-consequences (setting rewards or punishments). However, these strategies need to be adapted based on the individual's learning goals. Thus, self-observation is considered a critical process that guides individual's self-control to perform an activity. Self-observation consists of two processes: self-monitoring (mental tracking of the individual's performance) and self-recording (creating records of outcomes and learning processes).

The self-reflection phase is the last of the three phases and consists of two processes: self-judgements and self-reactions [1]. Self-judgements involve comparisons of an individual's performance with a standard such as prior performance, social comparison with others, or expert mastery. Self-reactions are composed of self-satisfaction (affective and cognitive reactions to the individual's self-judgements) and adaptive/defensive decisions (individual's willingness to further engage in the learning process or not). People who decide to further engage in the learning process, plan, monitor, and evaluate their actions based on the previously gathered experiences. It is worth mentioning that the Cyclical Model of SRL pays special attention to the reciprocal and dynamic interaction of the individual's behaviour and the environment (reciprocal determinism) [4]. In other words, individuals learn to self-regulate through social means such as social support, feedback, and modelling (observational learning) [1][4].

2. The Integration of Pacing and Sports Performance within the Cyclical Model of SRL

The cyclical model of SRL [1] seems to be applicable in elite performance sports. Successful athletes have to take responsibility of their own training and learning procedures over a period of multiple years and take appropriate actions to improve their pacing behaviour and stay motivated throughout the process [5]. To gain a better understanding of the self-regulatory aspects of pacing, herein, it will try to integrate different performance periods within the three phases of the cyclical model of SRL, similarly to Elferink-Gemser and Hettinga [5]. More specifically, the forethought phase of the cyclical model of SRL will be first examined, which is the period where individuals plan their appropriate pacing strategy in training (before competition; training period). During this phase, athletes should be able to set goals (e.g., keep a set pace for the first half of a 10 km race; pacing strategy) and plan how they will attain them (e.g., additional training sessions, twice a week) [1][5]. Subsequently, during the performance phase, athletes compete in an event (during competition), and they try to attain self-control through imagery (e.g., runners imaging themselves to appropriately distribute their energy during the race by taking into consideration the competitors' actions), help-seeking (e.g., basketball players asking instructions from a coach to improve their ball possessions' frequency during a game), and self-consequences (e.g., setting a reward for a pacing accomplishment). More importantly, athletes monitor and self-record their effort exertion, use numerous strategies to keep themselves motivated and adapt their effort exertion to optimally reach the exercise task goal [1][5]. Lastly, the self-reflection phase could be considered as the period after the participation of athletes in competition. After a competition, athletes judge their pacing behaviour based on specific standards (e.g., outcome of the competition, comparison with opponents or other athletes) and react accordingly [1][5]. On the basis of their self-judgements, athletes decide if they will continue to engage, adapt, and improve their pacing (adaptive decisions) or if they will avoid further efforts to learn and improve (defensive decisions) [6].

3. Social Environment, Pacing, and Sports Performance within the Cyclical Model of SRL

3.1. Forethought Phase

The social environment could be a noteworthy self-regulatory, pacing, and sports performance facilitator during this phase. It offers multiple opportunities in order to guide and assist athletes to set realistic performance goals before a competition. For instance, athletes can use opponents as goal setters, as their presence and/or their pacing behaviour could influence their goal setting and motivate them to engage in a specific pacing behaviour (e.g., athletes are planning how to optimise their pacing behaviour to perform better than their opponents) [7]. Athletes who are more oriented towards wins and losses (e.g., beating an opponent) plan their pacing behaviour and performance less appropriately compared to athletes who are more focused on their personal goals [8]. For example, better competitors could lead them to adopt unrealistic and/or ineffective pacing and performance goals [7][9], a finding that athletes and their coaches should take into consideration during the training period.

During the forethought phase, coaches have an important role in the facilitation of athletes' goal setting and strategic planning, two self-regulatory skills which are relevant to pacing. For instance, coaches' goals can influence the goals that athletes set for themselves [10]. Moreover, coaches who set more challenging goals (e.g., beat an elite athlete) and have higher expectations from their athletes have a positive impact on their performance [11]. It seems though, that setting of training and competition goals (short- and long-term goals) along with the coach (co-orientation) also plays an important role in improving athletes' skills, and potentially pacing, as it keeps them motivated and focused (e.g., their common goal is for the athlete to respond better to external factors such as the opponent during competition) [12][13]. When coaches and athletes are setting goals (e.g., based on the pacing behaviour of their opponents), special attention should be paid to athletes' personality. Athletes with a more internal locus of control (control over the events that influence peoples' lives) spend more time on-task when they set their own goals (self-set goals). Athletes with a more external locus of control (events that happen in peoples' lives are out of their control) spend more time on-task when coaches set their goals, and these goals could be dictated by their opponents' behaviour and/or abilities [14]. Thus, it might be more beneficial for coaches who coach athletes with external locus of control, to set their athletes' goals based on their opponents' behaviour/abilities. This mental visualisation of the goal could act as a motivational factor during the forethought (and later at the performance) phase [14].

To optimally develop and guide athletes' pacing, coaches can play a major role and help athletes to strategically plan their activities and empower them in making the right decisions at the right time, particularly in relation to energy distribution, training load distribution across a training period, and general fatigue and recovery management [15][16][17]. Coaches who want to facilitate the strategic planning process should give a lot of emphasis on how they can assist athletes to anticipate potential obstacles in competition (e.g., anxiety) and empower them to be prepared for future barriers (e.g., athlete has to compete against faster paced opponents) [16]. In order to engage athletes in the strategic planning process, coaches devote a lot of time to support athletes' motivational beliefs (motivation and self-efficacy, e.g., opponents can be used as external motivators), as this type of focus would lead athletes to their desired outcome [16]. These behaviours are in line with the findings of Goffena and Horn [17], where there is a relationship between autonomy-supportive coaching and athletes' strategic planning.

3.2. Performance Phase

During sports competition, athletes are constantly looking for information in order to monitor their pacing behaviour and achieve the specific performance goals that were established at the forethought phase. Their interaction with the opponents could facilitate these processes. Opponents could be characterised as the visual representation of a goal throughout the race, hereby providing direct feedback to the athletes about the progress of the competition and their own pacing behaviour and performance [18][19][20][21][22]. Thus, it is not surprising that the attention of athletes (with a purpose to monitor their actions) mainly focuses on the opponent, especially where there is a high interdependency between them [19][21][23][24][25]. For example, when athletes are experiencing a positive momentum in relation to their opponents, they are able to regulate more efficient their exercise intensity within the race compared to a negative momentum [26]. Another interesting finding is that, even if athletes performed significantly faster in head-to-head (against an opponent) compared to time trial (no opponents) cycling and running trials, athletes rated their perceived effort similarly in both conditions [18][21]. This finding could be explained by the notion that the opponents function as an external distraction that decreases the athletes' perceived exertion. During this phase, the opponents are the visual representation of a goal throughout the race and act as a motivational factor, shift athletes' attentional strategies, and influence their decision-making [27]. Thus, when athletes compete against others, they can better regulate their afferent feedback, their pain, and fatigue, information that seems critical in pushing the limits of athletes' sports performance [18][21][27].

In addition to all the above, the presence and the perception of the opponent during competition could play a role in athletes' decision-making process and self-control ability, as the behaviour of an opponent affects the actions of an athlete and acts as a help-seeking factor [22][28][29][30][31][32]. For instance, a faster starting opponent evoked a faster start compared to a slower starting competitor in 4 km cycling time trials [28]. Moreover, Zouhal et al. [30] observed that drafting behind a runner improved the athletes' performance in a 3 km trial, even in the absence of any physiological benefits. This finding indicates that following another runner may lead athletes to engage less in the decision-making process, a situation that decreases their cognitive loading (less depleting) and facilitates a more efficient self-control of their pacing during the competitive trial.

Coaches should take into consideration the important role of opponents on pacing and performance and prepare their athletes by engaging them in various competitive activities (against an opponent/s) that provide similar constraints in decision-making [28][30][33]. Due to the nature of sports competition, in this phase it may be more challenging for coaches to influence athletes' behaviour and their ability to monitor their actions [34][35][36][37][38][39][40]. However, the provision of motivational feedback and encouragement by the coach could alter athletes' activity monitoring, improve their attention, increase their objective performance, and may lead to a more appropriate pacing behaviour and improved sports performance outcome [34]. For example, external encouragement in both endurance and sprint trials resulted in improvements in athletes' performance (faster pace), but they also reported significantly higher perceived exertion levels compared to the control trials (no external encouragement) [35]. Additionally, as opponents could alter athletes' attention and improve their tolerance of fatigue [18][21], coaches' feedback could focus more on the opponents' actions and behaviour so they improve athletes' motivation, pacing behaviour, and performance.

There is also some evidence about the role of the coaches in athletes' self-control [39][40][41]. For instance, Englert et al. [40] demonstrated that athletes who engaged in autonomously motivated self-control performed better under pressure compared to athletes who engaged in extrinsically motivated self-control. This finding indicates that autonomously motivated self-control is less depleting and gives an advantage to athletes under high pressure situations [40]. Except for autonomously exerted self-control, imagery instructions provided by the coaches (method of self-control) could guide athletes towards an external focus of attention (e.g., opponents-related instructions) [41], a finding that could have potential application in pacing. Coaches who focus on external cues (e.g., opponents) could alter athletes' decision-making, facilitate their self-control abilities, and influence athletes' drafting, positioning, and packing behaviour during a head-to-head trial [28][30][41].

3.3. Self-Reflection Phase

In sports settings, the social environment plays a significant role in the self-judgements' and self-reactions' process of athletes through their comparison with opponents and their affective reactions [42][43][44][45]. At a situational level, especially in a competitive environment where direct comparison can become salient, it is not surprising that the athlete may be susceptible to judging competence, evaluating success and failure, and continue engaging in the learning process (restarting the cycle with the forethought phase) based on social comparisons (e.g., outperforming an opponent due to a more efficient pacing behaviour at the beginning of the race) [42][43]. These social comparisons could also influence athletes' affective reactions and cause athletes to experience positive or negative emotions towards their next performance [46]. The consequences of social comparison are interesting for pacing, as affective feelings are positively and/or negatively influenced by the opponents during a head-to-head trial and could alter athletes' performance [47][48]. For instance, racing against an opponent could cause early fatigue (due to high intensity) and negatively influence athletes' affective feelings [47][48]. Additionally, athletes experience more tension/pressure when they compete in groups compared to individual or one vs. one race [7]. The opponents' pacing abilities could also play a role in athletes' affective responses [48]. When athletes compete against a slower opponent, their affective feelings are increasing in the final stages of a 10 km cycling trial, which may be linked to increased certainty with regards to goal achievement [48]. Thus, through social comparisons opponents could play a significant role in the self-reflection phase and influence the further engagement of athletes in the pacing skills acquisition process [47][48].

References

1. Zimmerman, B.J.; Moylan, A.R. Self-regulation: Where metacognition and motivation intersect. In Handbook of Metacognition in Education; Hacker, D.J., Dunlosky, J., Graesser, A.C., Eds.; Routledge: London, UK, 2009; pp. 299–315.
2. Usher, E.L. Self-Efficacy for Self-Regulated Learning. In Encyclopedia of the Sciences of Learning; Seel, N.M., Ed.; Springer: Boston, MA, USA, 2012.

3. Deci, E.L.; Ryan, R.M. Intrinsic Motivation and Self-Determination in Human Behavior; Plenum Press: New York, NY, USA, 1985.
4. Bandura, A. Social cognitive theory of self-regulation. Org. Behav. Hum. Decis. Process. 1991, 50, 248–287.
5. Elferink-Gemser, M.T.; Hettinga, F.J. Pacing and Self-regulation: Important Skills for Talent Development in Endurance Sports. Int. J. Sports Physiol. Perform. 2017, 12, 831–835.
6. Jordalen, G.; Lemyre, P.; Durand-Bush, N. Interplay of motivation and self-regulation throughout the development of elite athletes. Res. Q. Exerc. Sport 2019, 42, 102–103.
7. Hibbert, A.W.; Billaut, F.; Varley, M.C.; Polman, R.C.J. Goal Orientation and the Presence of Competitors Influence Cycling Performance. Front. Psychol. 2018, 9, 1212.
8. Larumbe-Zabala, E.; García-Lluch, J.; Agea, E.; Peris-Delcampo, D. Goal-setting strategy and psychological differences in marathon runners compared by gender. J. Hum. Sport Exerc. 2019, 14, 725–735.
9. Tan, P.L.; Tan, F.H.; Bosch, A.N. Similarities and differences in pacing patterns in a 161-km and 101 km ultra-distance road race. J. Strength Cond. Res. 2016, 30, 2145–2155.
10. Bueno, J.; Weinberg, R.S.; Fernández-Castro, J.; Capdevila, L. Emotional and motivational mechanisms mediating the influence of goal setting on endurance athletes' performance. Psychol. Sport Exerc. 2008, 9, 786–799.
11. Staufenbiel, K.; Lobinger, B.; Strauss, B. Home advantage in soccer—A matter of expectations, goal setting and tactical decisions of coaches? J. Sports Sci. 2015, 33, 1932–1941.
12. Maitland, A.; Gervis, M. Goal-setting in youth football: Are coaches missing an opportunity? Phys. Educ. Sport Pedagogy 2010, 15, 323–343.
13. Philippe, R.A.; Seiler, R. Closeness, co-orientation and complementarity in coach–athlete relationships: What male swimmers say about their male coaches. Psychol. Sport Exerc. 2006, 7, 159–171.
14. Lambert, S.M.; Moore, D.W.; Dixon, R.S. Gymnasts in training: The differential effects of self-and coach-set goals as a function of locus of control. J. Appl. Sport Psychol. 1999, 11, 72–82.
15. Toering, T.; Elferink-Gemser, M.; Jordet, G.; Jorna, C.; Pepping, G.J.; Visscher, C. Self-Regulation of Practice Behavior among Elite Youth Soccer Players: An Exploratory Observation Study. J. Appl. Sport Psychol. 2011, 23, 110–128.
16. Collins, J.; Durand-Bush, N. Strategies Used by an Elite Curling Coach to Nurture Athletes' Self-Regulation: A Single Case Study. J. Appl. Sport Psychol. 2014, 26, 211–224.

17. Goffena, J.D.; Horn, T.S. The Relationship between Coach Behavior and Athlete Self-Regulated Learning. Int. J. Sports Sci. Coach 2021, 16, 3–15.
18. Konings, M.J.; Parkinson, J.; Zijdewind, I.; Hettinga, F.J. Racing an Opponent: Alteration of Pacing, Performance, and Muscle-Force Decline but Not Rating of Perceived Exertion. Int. J. Sports Physiol. Perform. 2018, 13, 283–289.
19. Konings, M.J.; Hettinga, F.J. Preexercise Cycling Protocol Alters Pacing Behavior in Competitive Time Trials. Int. J. Sports Physiol. Perform. 2020, 15, 1303–1308.
20. Konings, M.J.; Hettinga, F.J. The Impact of Different Competitive Environments on Pacing and Performance. Int. J. Sports Physiol. Perform. 2018, 13, 701–708.
21. Williams, E.L.; Jones, H.S.; Andy Sparks, S.; Marchant, D.C.; Midgley, A.W.; Mc Naughton, L.R. Competitor presence reduces internal attentional focus and improves 16.1km cycling time trial performance. J. Sci. Med. Sport 2015, 18, 486–491.
22. Bath, D.; Turner, L.A.; Bosch, A.N.; Tucker, R.; Lambert, E.V.; Thompson, K.G.; St Clair Gibson, A. The effect of a second runner on pacing strategy and RPE during a running time trial. Int. J. Sports Physiol. Perform. 2012, 7, 26–32.
23. Whitehead, A.E.; Jones, H.S.; Williams, E.L.; Rowley, C.; Quayle, L.; Marchant, D.; Polman, R.C. Investigating the relationship between cognitions, pacing strategies and performance in 16.1 km cycling time trials using a think aloud protocol. Psychol. Sport Exerc. 2018, 34, 95–109.
24. Whitehead, A.E.; Jones, H.S.; Williams, E.L.; Dowling, C.; Morley, D.; Taylor, J.A.; Polman, R.C. Changes in cognition over a 16.1 km cycling time trial using Think Aloud protocol: Preliminary evidence. Int. J. Sport Exerc. Psychol. 2019, 17, 266–274.
25. Hext, A.; Hettinga, F.J.; McInerney, C. Tactical positioning in short-track speed skating: The utility of race-specific athlete-opponent interactions. Eur. J. Sport Sci. 2022, 22, 1–10.
26. DenHartigh, R.J.; Gernigon, C.; VanYperen, N.W.; Marin, L.; VanGeert, P.L. How psychological and behavioral team states change during positive and negative momentum. PLoS ONE 2014, 9, e97887.
27. Brick, N.E.; Campbell, M.J.; Metcalfe, R.S.; Mair, J.L.; Macintyre, T.E. Altering Pace Control and Pace Regulation: Attentional Focus Effects during Running. Med. Sci. Sports Exerc. 2016, 48, 879–886.
28. Konings, M.J.; Schoenmakers, P.P.; Walker, A.J.; Hettinga, F.J. The behavior of an opponent alters pacing decisions in 4-km cycling time trials. Physiol. Behav. 2016, 158, 1–5.
29. Tomazini, F.; Pasqua, L.A.; Damasceno, M.V.; Silva-Cavalcante, M.D.; de Oliveira, F.R.; Lima-Silva, A.E.; Bertuzzi, R. Head-to-head running race simulation alters pacing strategy, performance, and mood state. Physiol. Behav. 2015, 149, 39–44.

30. Zouhal, H.; Ben, A.A.; Prioux, J.; Knechtle, B.; Bouguerra, L.; Kebsi, W. Drafting's improvement of 3000-m running performance in elite athletes: Is it a placebo effect? Int. J. Sports Physiol. Perform. 2015, 10, 147–152.
31. Noorbergen, O.S.; Konings, M.J.; Micklewright, D.; Elferink-Gemser, M.T.; Hettinga, F.J. Pacing Behavior and Tactical Positioning in 500- and 1000-m Short-Track Speed Skating. Int. J. Sports Physiol. Perform. 2016, 11, 742–748.
32. Konings, M.J.; Noorbergen, O.S.; Parry, D.; Hettinga, F.J. Pacing behaviour and tactical positioning in 1500 m short-track speed skating. Int. J. Sports Physiol. Perform. 2016, 11, 122–129.
33. Konings, M.J.; Foulsham, T.; Micklewright, D.; Hettinga, F.J. Athlete-Opponent Interdependency Alters Pacing and Information-Seeking Behavior. Med. Sci. Sports Exerc. 2020, 52, 153–160.
34. Fransen, K.; Boen, F.; Vansteenkiste, M.; Mertens, N.; Vande Broek, G. The power of competence support: The impact of coaches and athlete leaders on intrinsic motivation and performance. Scand. J. Med. Sci. Sports 2018, 28, 725–745.
35. Edwards, A.M.; Dutton-Challis, L.; Cottrell, D.; Guy, J.H.; Hettinga, F.J. Impact of active and passive social facilitation on self-paced endurance and sprint exercise: Encouragement augments performance and motivation to exercise. BMJ Open Sport Exerc. Med. 2018, 4, e000368.
36. Brandes, M.; Elvers, S. Elite Youth Soccer Players' Physiological Responses, Time-Motion Characteristics, and Game Performance in 4 vs. 4 Small-Sided Games: The Influence of Coach Feedback. J. Strength Cond. Res. 2017, 31, 2652–2658.
37. Halperin, I.; Chapman, D.; Martin, D.; Abbiss, C.; Wulf, G. Coaching cues in amateur boxing: An analysis of ringside feedback provided between rounds of competition. Psychol. Sport Exerc. 2016, 25, 44–50.
38. Halperin, I.; Chapman, D.; Thompson, K.G.; Abbiss, C. False-performance feedback does not affect punching forces and pacing of elite boxers. J. Sports Sci. 2019, 37, 59–66.
39. Bieleke, M.; Kriech, C.; Wolff, W. Served Well? A Pilot Field Study on the Effects of Conveying Self-control Strategies on Volleyball Service Performance. Behav. Sci. 2019, 9, 93.
40. Englert, C.; Bertrams, A. Autonomy as a protective factor against the detrimental effects of ego depletion on tennis serve accuracy under pressure. Int. J. Sport Exerc. Psychol. 2015, 9, 121–131.
41. Milley, K.R.; Ouellette, G.P. Putting Attention on the Spot in Coaching: Shifting to an External Focus of Attention With Imagery Techniques to Improve Basketball Free-Throw Shooting Performance. Front. Psychol. 2021, 12, 645676.

42. Bardel, M.H.; Fontayne, P.; Colombel, F.; Schiphof-Godart, L. Effects of match result and social comparison on sport state self-esteem fluctuations. Psychol. Sport Exerc. 2010, 11, 171–176.
43. Gotwals, J.J.; Wayment, H.A. Evaluation Strategies, Self Esteem, and Athletic Performance. Curr. Res. Soc. Psychol 2002, 8, 84–100.
44. Stuntz, C.P.; Boreyko, C.L. Predicting psychological need satisfaction from differential coach treatment: Does receiving more of the coach's attention than teammates matter? Int. J. Sport Exerc. Psychol. 2018, 16, 640–656.
45. Ruiz, M.C.; Appleton, P.R.; Duda, J.L.; Bortoli, L.; Robazza, C. Social Environmental Antecedents of Athletes' Emotions. Int. J. Environ. Res. Public Health 2021, 18, 4997.
46. Furley, P.; Moll, T.; Memmert, D. "Put your Hands up in the Air"? The interpersonal effects of pride and shame expressions on opponents and teammates. Front. Psychol. 2015, 6, 1361.
47. Crivoi do Carmo, E.; Renfree, A.; Nishimura Vieira, C.Y.; Ferreira, D.D.S.; Truffi, G.A.; Barroso, R. Effects of different goal orientations and virtual opponents performance level on pacing strategy and performance in cycling time trials. Eur. J. Sport Sci. 2022, 22, 491–498.
48. Crivoi do Carmo, E.C.; Barroso, R.; Renfree, A.; DaSilva, N.R.; Gil, S.; Tricoli, V. Affective feelings and perceived exertion during a 10 km time trial and head-to-head running race. Int. J. Sports Physiol. Perform. 2020, 15, 903–906.