

## Adopting an ecological perspective on skill performance and learning in sport

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## **Adopting an ecological perspective on skill performance and learning in sport**

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The sub-discipline of motor learning frames understanding of skill performance and learning in sports, relevant for developing talent and enhancing expertise of athletes (Ribeiro et al., 2020). These ideas have implications for the professional support work of practitioners such as coaches, trainers and sport scientists (Woods et al., 2020). Influenced and shaped by key ideas in biological, physical, social and anthropological sciences, an ecological perspective conceptualises athletes and sports teams as complex adaptive systems. Ecological dynamics is a contemporary, transdisciplinary theory of motor learning, expertise and talent development in sport, which investigates dynamic *person-environment interactions* as the relevant scale of analysis for understanding human performance. In sport, an ecological perspective helps sport scientists to conceptualise the functional relationship that emerges between the interactions of the individual athlete, task and environment, a relationship which is paramount in understanding skill adaptation and talent development.

Complex adaptive systems have inherent potential for system components to self-organise during interactions with the performance environment (e.g., continuous re-organisation of muscles, limbs, joints, segments in athletes and between teammates in a sports team) (Ribeiro et al., 2020). Evidence suggests that inherent coordination tendencies exist from embryonic to elderly stages of human development and can be exploited, in maturation, development and learning, to resolve coordination problems that people face throughout the lifespan (Button et al., 2020). Self-organisation tendencies can be harnessed as a foundation for learning complex coordination skills throughout life and adapting functional movement patterns in performance contexts like sport to interact with the constraints of dynamic environments.

Contemporary pedagogies have emerged from ecological dynamics, such as Constraints-Led coaching (Renshaw et al., 2019) and a Nonlinear Pedagogy (Rudd et al., 2021). These approaches to learning and development are shaping the way that sport practitioners provide

support for athletes and teams (Otte et al., 2021). Research has revealed key principles for applied sport scientists which can be taken from adopting an ecological perspective, including:

1. Ecological dynamics emphasises that *context is everything* in a motor learning theory that focuses on processes of coordination (between system degrees of freedom within each learner and between the learner and the environment). These coordination processes are captured as *skill adaptation* (Araújo & Davids, 2011) which help athletes acquire an increasingly functional relationship with a performance environment.
2. Understanding how skill adaptation emerges from learning and development over time has clarified that coordination *variability* plays an important role in supporting skill adaptation and enhancing athlete functionality (Caballero et al., 2017).
3. The *athlete-environment relationship* is paramount in understanding skill adaptation and talent development. Considering how athletes form successful relationships with their environments provides a relevant scale of analysis for understanding skilled behaviour (Button et al., 2020).
4. An ecological perspective promotes sport practitioners as '*designers*' of training and practice environments that provide *affordances* as opportunities which 'invite' actions of athletes and teams needed in competitive performance (Rudd et al., 2021).
5. Ecological dynamics provides a transdisciplinary approach to sports science support for professional practitioners in organisations to work together in a Department of Methodology (see Rothwell et al., 2020). Considering the merit of athlete-environment centred coaching designs, high-performance sport organisations need to effectively collaborate efforts of practitioners (including coaches, trainers, therapists, sport scientists and performance analysts) to design information-rich learning environments. A trend for growing numbers of sub-discipline specialists within sport organisations may lead to disjointed athlete development approaches or sections working in isolation (Otte et al., 2020). For example, head coaches may be faced with many methodical incongruencies when designing training environments together with different disciplinary support and specialist staff members, including scientific, medical, and performance analysts. An ecological perspective requires the functional blending of various methodologies and ideas into a *Department of Methodology* (DoM; Rothwell et al., 2020). While each sub-discipline's empirical and experiential expertise is preserved in a DoM, sections can collaborate together under shared theoretical principles and a unified conceptual framework of ecological dynamics. Put simply,

guided by a collective understanding of how athletes learn, multidisciplinary staff co-design individualised practice programmes for athletes, focused on exploration, discovery and adaptability (Otte et al., 2021).

6. The *natural attitude* towards research exploring learning and athletic performance in sport, reveals the world through what Weber (2019) termed *instrumental rationality*, which considers athletes to be the subject of study. Rarely, does research of this nature give athletes a voice to offer insights into their lived experiences of performance (Smrdu, 2015). This traditional approach can be problematic, because as Woods et al. (2021) have argued, athletes can provide critical information to inform more effective practice and learning designs. To address this challenge, and to investigate performance behaviours through an ecological dynamics lens, mixed methods designs are a viable way to investigate the key personal, task and environmental constraints that continually shape performance contexts. The combination of phenomenological (an ontology of human existence) qualitative interviews and quantitative performance analysis data can facilitate this approach and provide an in-depth transdisciplinary perspective of athlete performance (e.g., Seifert et al., 2017). Combining these methods can elicit rich information about key constraints placed on athletes during competition, and develop a greater understanding of embodied athletic experience, leading to the design of more meaningful and empowering learning environments that enhance athletic performance.

## **Summary**

Ecological dynamics is a contemporary, applied scientific approach to studying motor learning design, expertise and talent development in sports. It advocates a need to integrate the experiential knowledge of groups of specialist practitioners, framed by theoretical understanding of athletes as teams as biophysical adaptive systems, in a coordinated DoM in sports organisations. An ecological model for sport science support and preparation for competition can facilitate contextualised training and practice designs for individual athletes and teams.

## **References**

Araújo, D. & Davids, K. (2011). What exactly is *acquired* during skill acquisition?. *Journal of Consciousness Studies*, 18, 7-23.

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

Caballero, C., Davids, K., Heller, B., Wheat, J., & Moreno, F. (2019). Movement variability emerges in gait as adaptation to task constraints in dynamic environments. *Gait and Posture*, 70, 1-5. doi: 10.1016/j.gaitpost.2019.02.002

Otte, F. W., Davids, K., Millar, S-K., & Klatt, S. (2021). Understanding how athletes learn: Integrating skill training concepts, theory and practice from an ecological perspective. *Applied Coaching Research Journal*, 7, 22-32:  
<https://www.ukcoaching.org/resources/topics/research/applied-coaching-research-journal>

Otte, F.W., Rothwell, M., Woods, C., & Davids, K. (2020). Specialist Coaching Integrated into a Department of Methodology in Team Sports Organisations. *Sports Medicine - Open*, 6(1), 1-8. doi: 10.1186/s40798-020-00284-5

Renshaw, I., Davids, K., Newcombe, D., and Roberts, S. (2019). The Constraints- Led Approach (Routledge Studies in Constraints-Based Methodologies in Sport) (1st Edn). London: Routledge. doi: 10.4324/9781315102351-6

Ribeiro, J., Davids, K., Silva, P., Coutinho, P & Garganta, J. (2021). Talent development in sport requires athlete enrichment: Contemporary insights from a Nonlinear Pedagogy and the Athletic Skills Model. *Sports Medicine*, doi: 10.1007/s40279-021-01437-6

Rothwell, M., Davids, K., Stone, J., Araújo, D., & Shuttleworth, R. (2021). The talent development process as enhancing athlete functionality: creating forms of life in an ecological niche. In J. Baker & J. Schorer, *Talent Identification and Development in Sport: International Perspectives* (2nd ed.). NY: Routledge.

Rudd, J.R., Renshaw, I., Savelsbergh, G.J.P., Chow J.-Y., Roberts, W., Newcombe, D. & Davids, K. (2021). *Nonlinear Pedagogy and the Athletic Skills Model: The Importance of Play in Supporting Physical Literacy*. Routledge: London.

Seifert, L., Lardy, J., Bourbousson, J., Adé, D., Nordez, A., Thouvarecq, R., & Saury, J. (2017).

Interpersonal coordination and individual organization combined with shared phenomenological experience in rowing performance: two case studies. *Frontiers in Psychology*, 8, 75. doi.org/10.3389/fpsyg.2017.00075

Smrdu, M. (2015). First-person experience of optimal sport competition performance of elite team

athletes. *Kinesiology*, 47(2), 169-178.

Woods, C. T., Rothwell, M., Rudd, J., Robertson, S., & Davids, K. (2021). Representative co-design:

utilising a source of experiential knowledge for athlete development and performance preparation. *Psychology of Sport and Exercise*, 52.

doi.org/10.1016/j.psychsport.2020.101804

Weber, M. (2019). *Economy and society*. Harvard University Press.

Woods, C., McKeown, I., Rothwell, M., Araújo, D., Robertson, S. & Davids, K. (2020).

Sport practitioners as sport ecology designers: How ecological dynamics has progressively changed perceptions of skill acquisition in the sporting habitat. *Frontiers in Psychology: Movement Science and Sport Psychology*, 11: 654, doi:

10.3389/fpsyg.2020.00654