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Commentary on “towards a grand unified theory of sports performance”

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1. Commentary

Sports performance is one of the most complex areas of study as it is characterized by human activity close to its limits. Nothing we see in high performers in any sport can be considered “typical” of human endeavors. In fact, the physical and mental feats combined with the unique skills and abilities that only elite performers can display are characterized by the complex interactions of multiple variables most of the times pushed to the limits of what is possible. Limits that are periodically broken as evidenced by the progression of world records (Berthelot et al., 2008; De Koning, 2010; Nevill & Whyte, 2005; Nevill, Whyte, Holder, & Peyrebrune, 2007) and/or the development of new skills and abilities (e.g., FIG Women’s Artistic Gymnastics, 2014). The commendable approach taken by the author to try and define a grand unified theory of sports performance is not an easy task but it is argued that this approach could provide a theoretical framework to drive sports research agendas. The need to promote more inter- and multi-disciplinary approaches to study sports performance has been highlighted numerous times before as also cited by the author (Bishop, 2008; Sands & McNeal, 2000), and it has been a matter of debate for years in many countries. So far, it is clear that sports research has been biased towards mono-disciplinary approaches mostly favoring physiology or biomechanics (Williams & Kendall, 2007) and limited with regards to the sports studied. A publication bias is also very likely to exist as the nature of sports performance research is also completely different from laboratory-based work. Applied research is in fact mostly problem-driven, often field-based and it is highly likely to be compromised in research design and methodology, presents larger “noise” due to uncontrollable variables and it is typically characterized by low numbers of study participants. In my personal experience, supported by similar situations faced by colleagues mostly working in sport, all of the above factors always represented major challenges to publication in scientific journals. This last point is of particular importance and I will discuss this aspect within the realms of the real world scenarios.

Grand unified theories are in fact good academic approaches to try and define a consistent framework to try to advance science in a particular field. However they are at risk of being confined to the realm of intellectual debates if the applicability in the real world cannot be realized and/or key practical aspects and/or factors affecting the ability to apply the GUT approach are not considered. In light of this, it is very important to understand how the sporting landscape works. Nowadays, large investments in sports programs are provided by government institutions in many countries and they are targeted to win as many medals as possible at the Olympic Games. High performance sport in non-Olympic or professional environments is also funded by private corporations and it now constitutes business entities aiming to succeed not only on the sporting field but also in financial markets (e.g., football clubs listed on the stock exchange). A similar scenario is evident in collegiate sports in the U.S. where in the recent years, public universities invested more than \$10.3 billion in mandatory student fees and other subsidy funding into their sports programs [according to an examination by The Huffington Post and The Chronicle of Higher Education (Brad Wolverton, Ben Hallman, & Kambhampati, 2015)].

Sports performance happens in competitive environments. It is well known by practitioners in this field that applied research activities are conducted with the sole purpose of maximizing performance gains and/or knowledge in order to have a performance

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advantage. Knowledge in this case is power and many scientists working in academia make assumptions that interdisciplinary research does not occur in sport simply because their term of reference is the appearance of such efforts on peer-reviewed journals. This was evident for example in the expectations of some institutions and evidenced in the House of Lords select committee on Science and Technology (2012). Reality is that some of the multi-inter-disciplinary research I was involved in my role with the British Olympic team and/or other teams I was working for could not be released in the form of scientific publications due to the competitive aspects and/or could only be released in part and some years after a main sporting event (for example the work done with short track speed skaters in the lead up to Vancouver 2010 (e.g. [Hesford, Cardinale, Laing, & Cooper, 2013](#); [Hesford, Laing, Cardinale, & Cooper, 2012, 2013](#)). Furthermore, such applied research work is often limited in terms of sample sizes and research designs constraints that are often poorly comprehended by reviewers not familiar with the reality of high performance sport. This of course leads to very few scientific observations published in elite athletic cohorts. The last elephant in the room, which needs to be addressed before discussing the GUT approach presented in the paper is the issue of funding. Funding for sports performance research is virtually non-existing and/or extremely limited pretty much everywhere ([Beneke, 2013](#); [Reilly, 2001](#); [Stone, Sands, & Stone, 2004](#)), and in my view this is possibly one if not the biggest limit to interdisciplinary research approaches to sports performance. Some efforts in the lead up to the London 2012 Games have been able to contribute to create more interdisciplinary opportunities as manifested by the quality of some impact studies in the UK research excellence framework ([Research Excellence Framework 2014: Overview report by Main Panel C, 2015](#)). Time will tell us if they will continue and improve in both quantity and quality at least in the UK when the interest in Olympic endeavors fades in government institutions.

Last but not least, research efforts in sports performance can only happen if athletes and coaches understand the benefits of the process and can be engaged in activities that are relevant to support their efforts leading to success at national and/or international level. Many times in fact, research efforts seem to fail simply because they are not relevant to what the coaches try to do and/or perceive to be important ([Williams & Kendall, 2007](#)). So coaches are often the “gatekeepers” to interdisciplinary approaches and such hurdle can only be overcome with an improvement in coaching education offerings. In the UK, inconsistency of understanding scientific information independently of coaching qualifications was perceived to be a barrier to sports science engagement in some instances, as was the challenge of using the information in a meaningful way ([Martindale & Nash, 2013](#)). Others have already indicated that scientific publications are not the go-to source of information for coaches ([Kilic & Ince, 2015](#); [Reade, Rodgers, & Hall, 2009](#)), which prefer to learn by discussing with their peers and/or accessing coach-friendly journal, books and internet sources (also confirmed by our unpublished data, survey of Italian and international coaches conducted with the Italian Athletics Association $n = 820$, 2014). So there is a risk that even if excellent quality interdisciplinary research is funded, conducted and published, it may not reach the end user and all this effort is at risk to produce knowledge that is not put in practice.

Considering the fact that researchers are driven by academic institutions to ‘publish or perish’ in peer-reviewed journals, there seem to be no incentives to divulge scientific information to non peer-reviewed forums, books and/or coaching magazines. Recent developments in the research excellence framework in the UK have been introducing the requirement for each institution to provide impact studies of their research effort to showcase how science is impacting citizens. There is hope that such approach, if gratified with increased funding, might be an avenue to stimulate more research efforts and change attitudes towards the applied nature of sports research efforts. With this environment in mind, until all of the above improves, a theoretical framework runs the risk to remain only an interesting intellectual exercise. The constraints framework approach proposed in this GUT is appropriate in its general principles and macro-areas, albeit it misses a few aspects. Within the constraints clustered as organismic aspects there is no consideration of genomics advancements [for a recent update see ([Roth et al., 2012](#))] not only related to the identifications of performance traits but also to the adaptability of individuals to different training paradigms ([Bouchard et al., 1986](#); [Horsburgh, Robson-ansley, Adams, & Smith, 2015](#); [Voisin, Eynon, Yan, & Bishop, 2015](#)). In some sports where extreme physical traits are fundamental to performance (e.g., sprinting or extreme endurance events) studies should also take into account such aspects and not only focus on phenotypes. Furthermore, with the access to more and better “omics” techniques the next ten years should help us understand a bit more about these aspects. Another criticism to the GUT presented is related to identifying fatigue as the main physiological constraint when fatigue *per se* is an aspect of sports performance that requires an interdisciplinary approach as the inability to perform motor skills and/or produce required outputs may not be limited by physiological constraints only ([Ameredes, 2008](#); [Marcora & Staiano, 2010](#)). Finally, in the psychological constraints mostly focused on anxiety, emphasis should also be added the ability to learn and read the situations ([Hastie, Sinelnikov, & Guarino, 2009](#); [Kannekens, Elferink-Gemser, & Visscher, 2009](#); [Mermert & Furley, 2007](#)), which is a key performance aspect in many sports as well as elements of cohesion, group dynamics and communication ([Beauchamp, Maclachlan, & Lothian, 2005](#); [Widmeyer, Brawley, & Carron, 1992](#)) that have a strong influence on performance outcomes in team sports.

Finally, the GUT model is in practice what tends to happen in sports institutes where sports science activities are deployed to improve the understanding of the performance needs in a given sport and to improve the quality of coaching and add interventions to maximize performance. In my view, the GUT proposed represents a summary of examples of how different scientific disciplines can contribute to an improved understanding of sports performance and for sure as the author states with an improvement in wearable sensors [as we have also recently suggested ([Cardinale & Varley, 2016](#))] and the overcoming of measurement and analytics challenges, better holistic approaches to sports performance research can be deployed with minimal disruption to athletes. As someone who has spent more years in various sporting environments in different countries rather than university laboratories I can testify that the importance of an interdisciplinary approach to sports performance is very clear for applied scientists as for such individuals any scientific activity has to produce a tangible outcome to improve coaching and/or the quality of support provided to the athletes and coaches or has to provide a performance solution. Maybe the GUT proposed will help the academic specialists to appreciate the complexity of sports research and will highlight the needs to seek partnership in order to advance knowledge in this

field. However I believe that the accessibility to more and better funding streams for this research field can be the main catalyst for holistic research approaches independently from GUT or dynamical system theory.

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