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Innate talent in sport: Separating myth from reality

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COMMENTARY

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ABSTRACT

Twenty years ago, Howe, Davidson and Sloboda (1998) provided a state of the science review of innate talent. This paper was extremely influential although much has changed in the two decades since it was published. In this review, we revisit Howe et al's assessment and discuss current research on innate talent in sport, a domain that was largely ignored in the original review. After re-evaluating Howe et al's criteria for innate talent we conclude that with the exception of criterion 5 (i.e., talent is domain specific), these criteria are still useful in the context of existing evidence in sport. We subsequently examine two complementary issues: Is the concept of innate talent valid? Does the concept have any utility? We conclude the concept of innate talent is valid but currently has limited utility to those working in high performance sport. We highlight several areas of future research that will ultimately inform the value of innate talent to those working at the frontlines of athlete development.

Keywords:
Nature-nurture – athlete – development – giftedness – expertise

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The possibility that a person's ultimate achievement might lie in qualities transmitted at birth has dominated discussions for over two thousand years. In ancient Greece, Plato argued for a largely nature-focused view where all knowledge was present at birth (Cowie, 1999). The first scientific exploration of these varying influences can be traced to the work of Francis Galton and his book *Hereditary Genius* (Galton, 1869). This text formed the basis for more systematic examinations of concepts like talent, giftedness, and genius. Twenty years ago, Howe, Davidson and Sloboda wrote a seminal review of the evidence for innate talent in the journal *Behavioral and Brain Sciences*. This paper was extremely influential to many fields (citation counts as of September 2017 are 741 times on Google Scholar and 303 times on PsychInfo). In addition to a very extensive and thoughtful review, the journal provided 30 pointed commentaries from leading researchers that followed the target article. Much has changed in the field of talent science since 1998. Perhaps most significantly, the Howe et al. paper was written before the human genome was mapped in 2001, a development that has revolutionized most fields of science (e.g., medical genetics, genomics, proteomics). In this field, sport science, talent continues to be a dominant topic (see Baker, Cobley, Schorer, & Wattie, 2017). Questions like, *What is talent? Can we make accurate decisions about who is likely to succeed?* continue to preoccupy sport scientist and practitioners alike. In the sections that follow, we revisit Howe et al.'s review as it relates specifically to the domain of sport, a domain where talent and its early identification/selection/development remain a cornerstone of what sport science is and a domain that was largely ignored in the original review. We provide a state of the science review based on existing evidence from sport and borrowing from other areas of science where appropriate. Importantly, we have retained the vital discussions that come from targeted commentaries from leading scientists in this field followed by a short discussion of any issues raised in the commentaries.

Defining Innate Talent

In their original treatise, Howe et al. (1998; pp. 399-400) set up five criteria for their definition of innate talent:

1) It originated in genetically transmitted structures and hence is at least partly innate.
2) The full effects may not be evidenced at an early stage, but there will be some advance indications, allowing trained people to identify the presence of talent before exceptional levels of mature performance have been demonstrated.
3) These early indications of talent provide a basis for predicting who is likely to excel.
4) Only a minority are talented, for if all children were, there would be no way to predict or explain differential success. Finally,
5) talents are relatively domain-specific.

This definition is somewhat controversial; others have proposed different conceptualizations of what talent is and what this variable means for high performance sport, most notably Gagné's Differential Model of Giftedness and Talent, which has been used in several studies from researchers based at the Australian Institute of Sport (e.g., Gulbin, Oldenziel, Weissensteiner, & Gagné, 2010). Moreover, talent is conceptually distinct from expertise, which is defined as superior or exceptional performance compared to others in a domain (for further discussion see Baker, Schorer, & Wattie, 2015). However, the multi-faceted definition provided by Howe et al. was a reasonable basis for examining the evidence at the time. If we re-evaluate these five criteria, some still seem strongly supported while others need to be re-considered. In the next section we consider each criterion relative to the domain of sport.

Criterion 1 – *Innate talent is, at least partly, genetically transmitted*

By its very definition, *innate* talent must have some element of 'innateness' (i.e., a quality that is inborn or natural) and our use of this adjective is quite purposeful, distinguishing this concept from other descriptions of talent such as Gagné's, where it is seen as representing "outstanding systematically developed skills" (Gagné, 2004; p. 119). Perhaps one of the most considerable changes since the 1998 review has been the rapid advancement of the field of sport genetics. Starting in 2001, sport geneticists have published an annual (sometimes biennial) 'Gene Map' of genetic factors affecting performance and health-related fitness (e.g., the most recent iteration is Sarzynski et al., 2016). Collectively, this field of research is grounded in the assumption that genetic factors affect exercise, fitness and performance phenotypes (and vice versa).

Criteria 2-3 – *Talent will have some advanced indications and those with training can predict those with greater likelihood of success.*

One of the important themes that we will re-visit in this discussion is the relationship between theory and practice. Howe et al.'s second and third criteria are good examples of why this relationship is important to discussions of innate talent in sport. In a later section we discuss the evidence for the efficacy of advanced indicators for predicting later success. However, regardless of whether there is a strong theoretical or empirical rationale for innate talent, we would argue that coaching practice in high performance sport systems is consistent with criteria two and three. Sports may vary in their structure, policies and implementation, but the practice of attempting to identify talent and predict who has a greater chance of success (however defined) is common (Vaeyans, Lenoir, Williams, & Phillippaerts, 2008). This happens every time a coach makes the decision to select a young athlete to a competitive team or relegate them to recreational streams of participation. It also happens when scouts or coaches make decisions about who to offer athletic scholarships to at the college / university level, during recruitment to high performance youth academies (such as in soccer), and during entry drafts to elite amateur developmental leagues or professional sports teams. In particular, the identification and selection of very young athletes into more competitive/higher performance streams in order to accelerate athlete development (Vaeyans et al., 2008) presents a compelling example that criteria two and three are ubiquitous throughout sport. This identification can occur as young as six years of age, prior to when athletes have had the chance to acquire a meaningful amount of deliberate practice (Baker & Young, 2014; Ericsson, Krampe & Tesch-Römer, 1993). Indeed, as we were writing this review, the University of Hawaii offered an 11-year-old boy (an American Football Quarterback) an athletic scholarship (VanHaaren, 2017). Howe et al. (1998) asserted that it was important to explore the validity of the talent account because "researchers as well as educators rely on the talent account" (p. 400). We agree, and would add that in sport the predominant policies and structure of youth sport systems also reflect the talent account to a certain extent. In this case, the 'medium is part of the message'; the fact that ability streaming at very young ages is built into the structure of many youth sports embodies messages about innate talent (independent of a practitioner's belief). Therefore, by virtue of its ubiquity and the reliance on this account of talent in real world practices, this point still has relevance today, perhaps independent of the empirical support.

Criterion 4 – *Only a minority are talented*

At the outset of Howe et al.'s paper they summarized a number of different concepts and terms related to innate talent. These included "unusual excellence", "special ability", "possessed innately", "aptitude", "giftedness", and of course "innate talent". Explicitly or implicitly these terms suggest only a minority are talented, which is congruent with accounts of talent in sport. This criterion seems necessary at a logistical level (although we will discuss the biological basis for this premise in a later section). In sport, this refers to a small 'end-group' (i.e., teams and leagues at the highest level), with limited positions available. Moreover, even at the highest levels of sport there is evident variability in skill/capability between athletes. Indeed, this variability is cel-

ebrated via All-Star teams, myriad awards (e.g., Most Valuable Player, Ballon D'Or), and Hall of Fame inductions. Only a very small minority receives such accolades and acknowledgment for the special and unique level of ability (e.g., between 1% and 4% of professional athletes in the National Hockey League and Major League Baseball; Baker et al., 2015). Acknowledgment of 'talent' implies an increasingly exclusionary hierarchy. Again, independent of whether a person believes in innate talent, in a practical sense significant variation in skill and performance exists in sport (although some paradigms view talent existing within everyone: see Dries, 2013).

Criterion 5 – *Talent is relatively domain specific.*

In their review, Howe et al. emphasized that talent in a domain may result from different combinations of different skills, but, that notwithstanding, talents are relatively domain-specific (p. 400). However, on further reflection, the notion that talent is domain specific may be unreasonable. The idea that *expertise* is domain specific is relatively uncontroversial (e.g., see Loffing, Schorer, Hagemann, & Baker, 2012); however, the notion that humans would have an innate quality that would be specific to a single domain of endeavor does not seem to fit with biological parsimony. Nature is nothing if not thrifty. Therefore, if talent exists, it is more likely that it starts as a capacity that could predispose an individual to related domains (e.g., a genetic propensity to have a high proportion of fast twitch muscle fibers would predispose an athlete to many anaerobically-based sports) and that over time and through training, this general capacity adapts to become domain specific (see Simonton, 2017).[1]

The Howe et al. criteria were reasonable for conceptualizing their discussion of talent and our intention is not to re-examine each of these here, although discussions of innate talent invariably touch on these factors. Instead, we focus on providing clear conclusions on this issue for those working in the domain of sport. More specifically, we use sport-related evidence to justify two main conclusions. The first is that from a theoretical and conceptual perspective the notion of talent is reasonable. The second conclusion is that, at present, the concept of talent has very limited utility to the world of sport.

The concept of innate talent is valid

For the purpose of this discussion, we put aside dichotomized arguments about nature versus nurture. We have explored issues related to dichotomized and deterministic conceptualizations of nature versus nurture elsewhere (see Davids, & Baker, 2007; Wattie & Baker, 2017), as have others (Klissouras, 2001; Singer, & Janelle, 1999). Similarly, while discussions about whether innate talent is necessary and/or sufficient to explain expert sport performance often arise (i.e., arguments about degrees of importance, see Tucker, & Collins, 2012), in this section we focus on whether the concept of innate talent is reasonable from a theoretical perspective. Importantly, the premise of innate talent as a concept does not have to rely on a dichotomized or deterministic conceptualization (i.e., that innate talent is the sole determinant of sport expertise), but rather, there may be evidence supporting varying degrees of innate talent, where talent exists on a continuum.

The eminent geneticist and evolutionary biologist Theodosius Dobzhansky once remarked that 'Nothing in biology makes sense except in the light of evolution' (Dobzhansky, 1973). Indeed, evolution by natural selection has become such a dominant framework that most scientists agree that all biological phenomena (including discussions of innate talent) must fit with evolutionary principles. With regard to innate talent, a consequence of the genetic variation between individuals is that they can differ substantially from the population average on any number of characteristics. When individual characteristics favorably align with the specific requirements of a sport task (Davids, & Baker, 2007; Newell, 1986), this may reflect some level of 'innate talent' in the same way a genetic predisposition to be extremely tall may reflect an innate propensity for sports where height is an advantage. An evolutionary probabilistic standpoint assumes there is a distribution of ability and/or individual characteristics (i.e., degrees of talent) across a population with very small numbers of individuals at the very highest and lowest levels. In this paradigm, differences in innate predispositions are somewhat inevitable.

As many sports have matured, competition intensity and positional-specificity has increased. As a result, athletes' bodies have become more distinct from the general population and unique in accordance with the characteristics that probabilistically confer performance advantages in their sport. This has been referred to as the "expanding universe of athletic bodies" (p. 763, Norton, & Olds, 2001): the shift away from the notion of the 'ideal average body' toward niche bodies for specific sports and/or positions within sport. In many sports, athletes have increased in height and mass, and in those sports larger athletes may experience greater success (e.g., longer careers and greater economic rewards: Norton, & Olds, 2001). Moreover, these secular changes in morphology have outstripped any changes in the general population (see Norton, & Olds, 2001; Olds, 2001). For example, Norton, and Olds (2001) quantified this effect by calculating the "degree of superimposition of the frequency distributions" (p. 764) between the general population and elite athlete populations (age and sex matched). Their analyses suggest that there is a less than a 1% chance (i.e., 0.001) of finding someone with the size (height and mass) needed to be a lineman in the National Football League (from the general population of 20-29 year old males in the United States in the 1990s). Similarly, Norton, and Olds' (2001) analyses for National Basketball Association (NBA) players suggest a 5% chance of finding someone from the general population with

1 Incidentally, at face value this feature is also congruent with the principle behind 'talent transfer' initiatives (see Rea & Lavallee, 2017).

the size needed to play in the NBA (this statistics does not account for positional differences).

Importantly, characteristics like height are thought to be highly constrained by genetics, with most estimates suggesting that up to 80% of height is explained by genetic factors (McEvoy, & Visscher, 2009). Moreover, studies have suggested genetic origins for capacities related to strength, aerobic capacity and responsiveness to training (Bouchard et al., 1998; Bouchard et al., 1999; Calvo et al., 2002; Rankinen et al., 2006), and injury susceptibility (e.g., traumatic brain injury: Bennett, Reuter-Rice, & Laskowitz, 2016). The naturally occurring coordination patterns of some youth may also favourably align with the task constraints of specific sports (Chow, Davids, Button, & Renshaw, 2016; Davids, Button, & Bennett, 2008; Glazier, 2017), which may provide performance advantages and be construed as innate talent by practitioners. While a single gene explanation for genetic influences on sport performance is highly unlikely (see Davids, & Baker, 2007), these findings suggest genetic (or epigenetic) origins to predispositions for specific sport domains, and therefore the existence of different degrees of innate talent.

There are four important points that emerge from these secular trends and research on inter-individual differences in capacity, which align with the criterion of talent. First, which is relatively uncontroversial, is that anthropometrics and physiological capacity are important (some might say essential) to athlete development and success. The relationship between size and physical maturity with development performance has been well documented (see Malina, Cumming, Coelho e Silva, & Figueiredo, 2017), and task constraints within certain sports (e.g., the height of the net in basketball or the aerobic demands of cycling) favourably interact with individual-level characteristics. In some relatively 'closed' sports (e.g., diving, gymnastics), anthropometric and physiological characteristics might be a relatively greater constraint than more open sports. Second, there appears to be at least a partial genetic component to these underlying characteristics and capacities (see above). Third, by virtue of how uncommon the heights, masses, or physiological capacities of elite athletes are compared to the general population, these 'talents' are rare (Criterion 4). Last, such factors are consistent with individuals being predisposed to certain domains (see discussion of Criterion 5 above).

Conversely, talent cannot be reduced to relatively simple discrete measures like size, strength, speed, or aerobic capacity (see Abbott, Button, Pepping, & Collins, 2005). Instead, talent should be conceptualized as a multidimensional construct that cannot be aggregated to a single score and is comprised from different combinations of different abilities (Baker, Schorer, & Wattie, 2018). Indeed, a recent systematic review highlighted the particular utility of multidimensional approaches to talent identification (Johnston, Wattie, Schorer, & Baker, 2018). However, evolutionary or probabilistic accounts still allow for the confluence of different characteristics.

In addition to the theoretical and probabilistic arguments for the existence of innate talent, there are intuitive accounts from practitioners (e.g., coaches and scouts): 'I know *it* when I see *it*', or 'they just have *it*'. Often such claims emerge from the exceptional early performance of young athletes. These accounts could be dismissed as anecdotal and/or selective attention given retrospectively to only the instances of *successful* talent identification. Conversely, perhaps anecdotes from experienced practitioners should be given more credence in discusses of rare outcomes, like innate talent, than they generally do in scientific discussion. Moreover, in this context it may be worth discussing whether notions such as statistical significance and power are ecologically valid when considering the identification of a necessarily small, exceptional sample.

While talent is nebulous, hard to define and to observe, there are signs that it exists via proxies and theory. From our perspective, there is sufficient, yet indirect, evidence to support its existence, even though its existence at present is largely theoretical. Therefore, it is incumbent upon researchers and practitioners to refine our understanding of that concept and to test its falsifiability. We conclude that based on the available evidence, innate talent as a theoretical construct is defensible. However, the distinction between whether it makes sense as a theoretical concept versus as an applied (or practical) concept is important.

Current conceptualizations of talent have limited utility in the 'real world'

In the section above we conclude that there is a theoretical and conceptual rationale for the notion that individuals differ on qualities that might have some relevance for performance in specific tasks. This is a long way, however, from concluding innate talent is a useful concept for athletes, coaches, parents and administrators. In order to have 'real world' utility, talent needs to be measureable using valid and reliable tools. In the following section we examine evidence for the existence of these indicators.

The notion that there may be early indicators of future elite sport performance is a cornerstone of sport science, and has been since the earliest phases of the field. In the 1950s and 1960s, sport researchers explored general capacities that might explain how certain people succeed in athletic tasks (following on the notion of Spearman's G, developed to represent a general quality of intelligence, Spearman, 1904). One example is the concept of the *generalized motor ability,* which is built on the notion that a) individual motor skills are related to one another, b) a single global ability underpins each ability, and c) people are capable of performing all motor skills at similar levels. A similar concept, *motor educability,* refers to the general ability to learn motor skills (i.e., those with high motor educability more easily learn motor tasks, see for example, Gire, & Espenschade, 1942; Gross, Griessel, & Stull, 1956; McCloy, 1937). Although there was considerable research exploring these concepts, the evidence for them is not strong (see, for example, Drowatzky, & Zuccato, 1967). While the search for general tests of motor coordination

that might inform talent detection has seen renewed interest in recent years (see Faber et al., 2014; Vandorpe et al., 2012), the attention to 'sport genetics' has dominated many contemporary discourses.

Over the past two decades, the field of sport genetics has expanded considerably. The identification of specific genes, whose presence might be used to predict whether someone is more likely to succeed in a given domain, would arguably reflect a critical marker of innate talent. During this period, genetic research has noted several intriguing findings that might relate to the concept of innate talent. For instance, early studies highlighted the gene for Angiotensin Converting Enzyme (ACE), which influences blood pressure and fluid-electrolyte balance. Initial examinations of endurance athletes ranging from Olympic rowers (Gayagay et al., 1998) to Ironman triathletes (Collins et al., 2004) suggested this gene might be important in endurance tasks. Similarly, research on other genes including COL5A1 (e.g., Collins, Mokone, September, van der Merwe, & Schwellnus, 2009; Mokone, Schwellnus, Noakes, & Collins, 2006) and Alpha Actin 3 (MacArthur, & North, 2004) has supported the notion that the presence or absence of certain genes may predict athletes from non-athletes. It is important to note that predicting athletes from non-athletes is appreciably easier than predicting who among a group of athletes has greater potential.

In addition to these explorations of genetic markers, recent discussions of talent development have considered predicting talent from indicators of long-term engagement. The basis of this argument comes from the extensive period of training that seems to be required for expertise (Baker, & Young, 2014). If one is able to predict who is more likely to meaningfully engage in intensive training for several years then this might reflect a proxy of innate talent. For example, an athlete's ability to regulate their own learning is emerging as a key variable distinguishing elite performers from those of lower levels of skill (Toering, Elferink-Gemser, Jordet, & Visscher, 2009) and researchers have begun to explore the relationship between self-regulatory processes and practice behaviors in sport (Elferink-Gemser et al., 2015; Tedesqui, & Young, 2015). Similarly, studies have noted the relevance of personality variables such as self-control and grit to elite athlete development (Tedesqui, & Young, 2017a, 2017b). Better understanding of how these variables change over time and how they interact with training and other environment and genetic factors will improve our ability to identify those with the greatest potential for future success.

One of the concerns with the genetic studies noted above is that the work in this area is still emerging and considerable replication and extension is required before these findings will have the robust validity necessary to make conclusions about their importance. While these areas of research are promising, genetic researchers warn against their use in talent identification settings – at least given our current understanding (see Loland, 2015; Vlahovich, Fricker, Brown, & Hughes, 2017; Webborn et al., 2015). However, it is important to note this does not mean we have sufficient evidence to dismiss the concept of innate talent that might one day be recognizable through direct-to-consumer genetic tests. *The absence of evidence is not evidence of absence*. As technologies and methods improve and our ability to capture the complex interactions between genetics and environment increases, our capacity to identify qualities that predict future outcomes (e.g., behaviour, attainment) should improve. Nevertheless, the utility of innate talent to those working with athletes as coaches, trainers and administrators currently appears to be limited.

Key Issues in Future Work

Having set out our conclusions regarding talent, at least as it is currently understood, we conclude with a discussion of key areas for researchers to consider in future work.

Measurement

One of the challenges of bridging gaps between talent as a concept and the actual utility of that concept in applied contexts relates to measurement. First and foremost, many attempts to identify talent rely on the measurement of discrete and unstable characteristics (Abbott et al., 2005). These characteristics also tend to be predominantly physical measures (Johnston et al., 2018) that can directly influence an athletes' performance on a range of tasks than can underpin sport performance more broadly (e.g., speed and strength). However, performance does not necessarily equal talent, as demonstrated by the poor correlation between current performance and future performance (Baker et al., 2017). Moreover, inherent to unstable characteristics is their non-linearity (e.g., inter-individual differences and intra-individual differences in growth and maturation), which can increase the likelihood of both Type I and II errors when relied upon too heavily.

Another challenge to reconciling the concept of innate talent with its real world utility is whether or not it is sufficient to measure talent indirectly, or if it is necessary to measure it directly. For example, can measurement of the expression of talent be enough to count as 'measuring talent'; the expression of talent often being performance. Whether or not it is sufficient to measure talent directly or indirectly likely also relates to one's definition of talent. However, as a matter of necessity, this is an issue that might have to be resolved, or at least the implications of which better understood, until our measurement technologies and understanding of genetics and gene-environment interaction increases.

Replication

The world of high performance sport moves rapidly, much more rapidly than the scientific peer-review process. As a result, coaches, athletes and administrators are often quick to embrace new findings in an effort to obtain a competitive advantage over their opponents. However, this can result in aimless trips 'down the rabbit hole' before the reliability and validity to

these findings has been established. It is important to note that much of this emerging work requires considerable additional research replicating novel results and determining the extent to which they are generalizable to athlete populations *en masse*. One recent example of this is the landmark Great British Olympians project (Hardy et al., 2017), which sought to understand the developmental differences between athletes who won multiple medals at major championships and a matched group of high performance athletes who did not achieve the same level of success. This study, and a host of others in this area (e.g., Baker et al., 2003; Ward, Hodges, Starkes, & Williams, 2007), relied on retrospective recall of athletes in identifying key factors (e.g., life and training histories, etc.) that may have promoted superior development in some groups over others. It is critical to remember that sport systems are constantly in flux, evolving as political and social desires change. As a result, retrospective and longitudinal studies may adequately explain the antecedents of optimal development for athletes who competed in the past but arguably have limited relevance for athletes outside this generation.

Extension

In a recent systematic review, Johnston et al (2018) lamented the clear lack of systematic, longitudinal work in the field of talent in sport. They highlighted the need to extend our conceptualizations of talent and its development to more appropriately model the complex and interactive effects of environment and genetics. The majority of past research has focused on physical and anthropometric variables, arguably because they are the easiest to objectively measure. However, in most sports, predicting future performance can be startlingly complex and is never entirely determined by one class of variables. Most approaches to athlete development, by researchers and practitioners alike, tend to focus on the identification of a single approach or model to explain this development process when there could be varying pathways to get to the same endpoint. For example, one athlete may have a superior genotype for a desirable anthropometric profile and as a result becomes a player who uses her height/body as the advantage while a second athlete, who does not have these anthropometric advantages, develops superior decision-making and play-reading skills.

Implications

If the constituent components of talent (i.e., talent characteristics) exist on a continuum, from none or very little to a high degree, then there may be a need to evaluate how we deal with components of talent. First, talent may need to be considered as a multidimensional construct that can be composed of different permutations and combinations of characteristics and abilities (see Baker et al., 2018). Cluster analyses and methods that consider the composition of multiple variables may be particularly useful going forward, and such methods may increase the utility of talent identification measures. Second, the continuum conceptualization of innate talent implies that there is likely an acceptable range of values for specific characteristic and/or ability, and that ranges along continuums are outside the realistic threshold to be considered 'talented' in a specific domain. The challenge is that thresholds are obviously difficult to assess during youth and adolescent development, and would themselves have to be dynamic. Once we have a better understanding of the probability estimates for measures of talent and/or performance, then more accurate threshold for athlete selection can be prescribed. Last, if we conceptualize talent along continuums with probability estimates, then we need methods that match this conceptualization. Bayesian inference (see Bayarri, & Berger, 2004; Eddy, 2004), and the use of dynamic and flexible prior probabilities to inform likelihood estimates, may be a useful direction going forward. This would also allow practitioners to better understand the implications of evidence about talent (e.g., that it is probabilistic not deterministic; that inefficient systems have higher levels of Type I and II errors).

Another implication for our position could be that in lieu of good measures of innate talent, practitioners should focus exclusively (or nearly exclusively) on the environment, specifically deliberate practice (Baker & Young, 2014; Ericsson et al., 1993). Some practitioners undoubtedly already do this, and a number of popular books advocate this approach to athlete development (e.g., Syed, 2010). This would certainly be an unintended consequence of our argumentation. We have argued elsewhere that this type of deterministic approach, and the message that deliberate practice is sufficient to explain different levels of achievement, can be harmful (Wattie & Baker, 2017). Moreover, simplistic views such as those expounding that a single factor (e.g., genetics or deliberate practice) run the risk of being over-parsimonious to the point of obfuscation. Consider this thought exercise: Imagine a sport and context where there is considerable popularity for deliberate practice among practitioners and parents. Youth participation is professionalized from young ages, and young athletes have to engage in similarly structured deliberate practice. Perhaps coaches even strictly monitor and mandate the same amounts of deliberate practice for each athlete. Would such a context, where differences in the environment are effectively eliminated, actually serve to increase the influence of innate biological difference in athlete development? Unless proponents of this deterministic environmentalism in our thought exercise are willing to assert that all athletes will experience exactly the same developmental outcomes, then some differences between athletes would have to be the result of innate biological differences (e.g., due to injury risk, responsiveness to training, rates of learning, or anthropometric advantages). The world in our thought experiment is undoubtedly an over-simplification, and is a bit facetious. Nevertheless, versions of this example could be an unintended consequence of not considering the theoretical plausibility for the existence of innate talent; regardless of whether we can accurately measure innate talent.

Concluding Thoughts

Our intentions with this review were to celebrate the contribution of Howe et al. 20 years ago and highlight how innate talent is conceptualized and applied in the field of sport science. Based on existing theoretical and empirical evidence, the notion of innate talent appears valid given key theoretical principles that govern the sciences underpinning sport science (e.g., biological diversity, natural selection as a mechanisms of continued species evolution). However, the theoretical principles that support the existence of innate talent also stipulate that it exists along a continuum and that it is necessary but not sufficient to explain exceptional performance. As such, any understanding of innate talent cannot be divorced from the necessity to understand the complete ecology of the developmental environment.

However, in order to have any utility in the training environment, talent (whatever it is) needs to be measurable and with the exception of a few variables related to body size, no robust indicators of talent currently exist. Moreover, examinations of long-term predictions indicate very poor accuracy in talent selection decisions suggesting that sport systems grounded in early identification of talent may do more harm than good, although the size of the effects are largely unknown due to a lack of research in this area. The 20 years since Howe et al's review have seen rapid and meaningful advancement in our understanding of talent in sport but this understanding is far from complete. Continued evaluation and discussion will ultimately determine the value and cost of this concept in sports systems that are currently underpinned by early selection of athletes into more and more specialized pathways.

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The authors have declared that no competing interests exist.

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All relevant data are within the paper.

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