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Defining Elite Athletes: Issues in the Study of Expert Performance in Sport Psychology

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Abstract

Objectives: There has been considerable inconsistency and confusion in the definition of elite/expert athletes in sport psychology research, which has implications for studies conducted in this area and for the field as a whole. This study aimed to: (i) critically evaluate the ways in which recent research in sport psychology has defined elite/expert athletes; (ii) explore the rationale for using such athletes; and (iii) evaluate the conclusions that research in this field draws about the nature of expertise.

Design: Conventional systematic review principles were employed to conduct a rigorous search and synthesise findings.

Methods: A comprehensive literature search of SPORTDiscus, PsycINFO, PsycARTICLES and Academic Search Complete was completed in September, 2013 which yielded 91 empirical studies published between 2010 and 2013. The primarily qualitative findings were analysed thematically.

Results: Eight ways of defining elite/expert athletes were identified, ranging from Olympic champions to regional level competitors and those with as little as two years of experience in their sport. Three types of rationale were evident in these studies (i.e., "necessity", "exploratory" and "superior"); while findings also indicated that some elite athletes are psychologically idiosyncratic and perhaps even dysfunctional in their behaviour. Finally, only 19 of the 91 included studies provided conclusions about the nature of expertise in sport.

Conclusions: This study suggests that the definitions of elite athletes vary on a continuum of validity, and the findings are translated into a taxonomy for classifying expert samples in sport psychology research in future. Recommendations are provided for researchers in this area.

Keywords: athletes, cognitive psychology, experience, expertise, performance, talent.

Defining Elite Athletes: Issues in the Study of Expert Performance in Sport Psychology

Whether out of envy or admiration, we have long been fascinated by the breath-taking feats of expert or "elite"[1] athletes, such as the footballer Lionel Messi or the tennis star Rafael Nadal, who can perform apparently impossible skills with remarkable consistency and precision. In an effort to understand the cognitive and neural processes that underlie such exceptional skills, researchers in disciplines such as cognitive psychology, sport psychology, motor learning/skill acquisition, kinesiology and neuroscience have developed a field of inter-disciplinary inquiry that is concerned with the scientific study of 'expertise' or the growth of specialist knowledge and skills through effortful experience (see Ericsson, 1996, for a detailed introduction). Although empirical research on expertise is little more than four decades old, psychological speculation about the nature and determinants of eminence in human achievement dates back at least as far as Galton (1869). Interestingly, whereas the first modern studies in this field (in the 1960s and 1970s) were conducted mainly on performance in formal knowledge domains such chess (e.g., see de Groot, 1965; Chase & Simon, 1973), more recent research (since the mid-1990s) has explored expert-novice differences in largely perceptual-motor domains such as dance (Bläsing et al., 2012) and sport (e.g., Müller et al., 2010; Williams & Ford, 2008). Regardless of the domain under investigation, however, research on expertise is now a "hot topic" in psychology. To illustrate this trend, expertise has attracted distinctive methodological paradigms (e.g., Ericsson, 2013; Ericsson & Ward, 2007); special issues of academic journals such as *Applied Cognitive Psychology* (Ericsson, 2005), *Journal of Experimental Psychology: Applied* (Ericsson & Williams, 2007) and *Journal of Sport & Exercise Psychology* (Williams & Ericsson, 2008); several scholarly

[1] We shall use the terms elite and expert interchangeably, as did Starkes and Ericsson (2003).

handbooks (e.g., Ericsson et al., 1996; Staszewski, 2013); and considerable interest from popular science writers (e.g., Colvin, 2008; Gladwell, 2009; Syed, 2010). Arising from this confluence of research activity, evidence has accumulated to show that expert athletes differ consistently from relative novices with regard to a variety of perceptual, cognitive and strategic aspects of behaviour (see summary in Eklund & Tenenbaum, 2014). For example, compared to their novice counterparts, expert athletes tend to have a more extensive knowledge-base of sport-specific information and to be more adept at using this knowledge efficiently to identify, remember and manipulate relevant information in their specialist sport. To summarise, on the basis of the preceding evidence, it seems reasonable to conclude that research on expertise is a thriving and productive scientific endeavour.

Unfortunately, this latter conclusion may be challenged on the grounds that there is considerable confusion and inconsistency among expertise researchers with regard to the criteria used to define the term "elite" or "expert" athlete (Polman, 2012). For example, despite widespread acceptance of the "ten year rule" (Hayes, 1985) – or the assumption that it takes about 10 years of sustained deliberate practice to become an expert in any field or 10,000 hours (as popularised by Gladwell, 2009) – the terms "elite" and "expert" have been ascribed to athletes with as little as *two years* of accumulated practice (e.g., Welch & Tschampl, 2012). Similarly, they have been applied in a rather cavalier fashion to such heterogeneous samples as Olympic champions (e.g., Grant & Schempp, 2013), professional performers (Jordet & Elferink-Gemser, 2012), inter-varsity athletes (e.g., Steiner et al, 2010), members of national squads (Bertello et al, 2012), and athletes who were simply part of a competitive team (Voss et al, 2010). Clearly, such imprecision in the criteria used to define participants as "expert" athletes threatens the validity of research on expertise in sport. For example, at a theoretical level, it is difficult to draw valid conclusions about expertise from studies in which experts have been defined using significantly different criteria.

Unfortunately, the extent of this definitional problem at the heart of expertise research has not yet been investigated systematically. Furthermore, few guidelines are currently available to help researchers define "expertise" as objectively as possible in the study of sport

Against this background of confusion, the present paper attempts to fill three main gaps in the field by providing a review of research that has sampled elite/expert athletes. First, we aimed to analyse, and evaluate the validity of, the definitions used by researchers studying such participants. Second, we aimed to explore the rationale provided by the authors of these studies for employing elite/expert athlete samples. This information is crucial in determining the extent to which these studies sought to increase theoretical understanding of expertise. Thus our third aim was to explore the general theoretical conclusions that have been drawn about expertise from research with these athletes.

Method

Development of Search Strategy

Our review used conventional systematic review principles in order to ensure the rigorous selection of studies based on replicable criteria (cf. Smith, 2010; Centre for Reviews and Dissemination [CRD], 2009). To begin, a list of key words was trialled in a preliminary search on the SPORTDiscus database, and the findings from this exploratory search were reviewed so that the most efficient and effective search terms could be identified. The main focus of this review was definitions relating to *elite* or *expert* athletes, and therefore we primarily sought to retrieve studies which explicitly used these terms. Other relevant terms (e.g., "skilled" or "experienced") were initially trialled but combining these with *elite/expert* produced either an excessively high (over 280,000) or overly restrictive (just 300) number of possible inclusions, and therefore the terms *elite/expert* were prioritised. Furthermore, this review was primarily concerned with sport psychology research, but to capture studies from overlapping areas (such as motor control/performance and skill acquisition) we also included

cognitive psychology and *neuroscience* in the search. The trialling process also identified a number of irrelevant terms that were designated as 'limiters' to be removed them from the final results. The list of search terms employed was:

(elite OR expert*) AND athlet* AND sport AND (psychology OR neuroscience)
NOT (adolescent OR youth OR junior OR review)

The databases deemed to be most relevant (based on accessibility and relevance to the topic area), and therefore searched via EbscoHost, were SPORTDiscus, PsycINFO, PsycARTICLES, and Academic Search Complete.

Inclusion/Exclusion Criteria

Inclusion/exclusion criteria were employed to ensure that the boundaries of the review were clearly defined, and that the search strategy would identify all literature relevant to the aims of the review (CRD, 2009; Smith, 2010), while also keeping the number of inclusions manageable (which we deemed to be less than 100). The studies included in this review needed to be: (i) peer-reviewed research studies published in the English language; (ii) published (either in paper or online) between 2010 and September, 2013 when the formal search was finalised; (iii) original empirical, primary evidence/data; (iv) concerned primarily with either sport psychology or cognitive psychology/neuroscience (e.g., published in journals in these fields); (v) ones that explicitly described their sample as "elite" or "expert" in either the title or abstract (e.g., studies were excluded if they mentioned expertise but described *their* sample as "skilled" instead); (vi) ones that explicitly referred to elite *athletes*, and not coaches, referees, parents, or panels; (vii) ones that involved sporting activities as defined by the Oxford Dictionary of Sports Science and Medicine (Kent, 2006); (viii) ones that did not refer to young, junior, or adolescent elite athletes in the title, abstract or full-text (unless they *also* used, and provided data about, elite athletes in their sample); and (ix) as a

final measure to help reduce the number of returns towards the 'manageable' threshold, all included studies needed to be published in journals with an impact factor.

Search Returns

The search process was finalised on the 14th of September, 2013, and initially returned 731 potentially relevant studies. After duplicates and studies not published in English were removed, the titles and abstracts of the remaining potential targets were assessed for relevance. This step reduced the potential target papers to 240 articles. Another 80 papers were removed because they were not published in journals with an impact factor. Full-text copies were then obtained for the remaining 160 studies, after which a further 69 were excluded either because: (a) they stated in-text that they used young/junior athletes; (b) they were not sufficiently focused on psychology; or (c) they did not explicitly describe their sample as elite or expert (e.g., some mentioned 'expertise' in the abstract but referred to their sample as 'skilled' or 'experienced' instead). In total, 91 studies published in 28 different journals met the inclusion criteria (as described in Table 1). All of the current paper's authors were involved in the process of determining which studies should be included. In cases where studies did not clearly meet criteria, discussions took place until all authors agreed on how to proceed (i.e., either by including or excluding the studies in question).

[INSERT TABLE 1 NEAR HERE]

Data Extraction and Synthesis

Once the final 91 studies had been identified, the relevant sections in each were repeatedly read by the lead researcher (first author) in order to become familiar with, and immersed in, the data to fully appreciate its significance (see Maykut & Morehouse's [1994] concept of *indwelling*). Data pertaining to the three main research questions were extracted by the first and third authors, and included in an audit trail which was verified by all authors (e.g., by processes of peer debrief and investigator triangulation; see below). As the data were

primarily qualitative, a process of thematic analysis was used to identify, group, and summarise the most relevant issues/themes emerging from the included studies (Pope, Mays, & Popay, 2007). A team approach to analysis was adopted whereby each of the authors was presented with the table of extracted data and separately analysed it before offering critical feedback and reaching agreement on the results (e.g., key themes that emerged).

Reliability/Trustworthiness

Since qualitative analysis procedures were used to categorise the data (i.e., see thematic analysis; Braun & Clarke, 2006), a number of processes were followed in order to enhance the trustworthiness, quality, and rigour of our work (Seale, 1999; Sparkes & Smith, 2009). The issue of reliability was addressed by attempting to achieve consensus in article inclusion, as well as during data extraction and data coding. To facilitate researcher triangulation, peer debrief (e.g., Creswell & Miller, 2000; Lincoln & Guba, 1985) was also employed. This process took place between the lead researcher (first author) and the second and third authors who provided guidance on the process of conducting the review, and on research on expertise in sport. Peer debrief took place throughout this study, by way of regular formal meetings and informal discussions. Finally, the audit trail discussed above was created and checked by all three authors to enhance transparency. This document is available on request from the first author.

Results

General Findings

The 91 papers included in this review comprised a total population size of 8572 elite/expert athletes, made up of 3482 males (40.6%) and 2598 females (30.3%) – the remaining 29.1% of the sample were in studies which did not denote the sex of their athletes. 101 independent samples were included as some papers reported more than one study. However no athletes were used twice in the samples in these studies. Overall, 59 studies

employed whole samples from one single sport, whereas 28 studies used multi-sport samples, and four did not describe which sports their athletes competed in. The most frequently-sampled sports were football/soccer (*N*=16), swimming (*N*=16), basketball (*N*=14), and rowing (*N*=12). By contrast, the least frequently-sampled sports included mountain running, adventure racing, roller hockey, artistic roller-skating, windsurfing, and bowls (all *N*=1). In the case of 13 studies, the whole sample was not used because they included athletes who did not meet the inclusion/exclusion criteria (e.g., they were novices). In these latter cases, we used details for the expert athletes only.

Definitions of Elite/Expert Athletes

The 91 included studies explicitly described their samples as elite and/or expert. Eight broad categories of definition of elite/expert athletes emerged, all of which are summarised in Table 2. Where the studies provided a mean value (e.g., for "years of competitive experience"), all available scores were added and divided by the number of studies to identify an average for the sample as a whole. Interestingly, some studies provided a *range* of definitions for the sub-samples used, for example in the 28 studies that included athletes from more than one sport, such as regional level to international level (Chan & Hagger, 2012; Young & Salmela, 2010). This means that, for example, the studies defining their athletes at regional level did not necessarily mean that the *whole* sample was at that standard. It should also be noted that many studies provided multi-faceted definitions for their sample which could span a number of the categories below. Each of the eight forms of definition is described below, in order of decreasing frequency of usage.

[INSERT TABLE 2 NEAR HERE]

International and/or national competitive level. This theme was reported most often by the studies, with 61 (67% of the sample) defining elite/expert athletes as those competing at international and/or national level. It was difficult to separate international and

national level (e.g., due to studies reporting themes such as *competing at international and/or national level*; *N*=14), while other athletes who *represent their country or national team* (*N*=25) could potentially be competing at both national and international level at that time in their career. The sub-categories ranged from those with success at major international competitions such as the Olympic Games or World Championships (e.g., medals, titles or records; *N*=6), to those participating/competing at national level (*N*=12), and national second-level (e.g., Wu et al, 2013). *Participation in national leagues* was reported by five studies that did not disclose the professional status of the league, implying amateur status. Furthermore, in some cases there were differences between international amateur level and professional international level. For example, Bernier et al, (2011) included some golfers who had participated in international amateur tournaments, and others who had competed on various professional tours (Alps Tour, Challenge Tour, European Tour).

Experience. The second most common way of defining elite/expert athletes was in terms of their experience, as reported by 45 studies (49% of the sample). In particular, the sub-category *experience in general* was reported by 24 studies (26% of the sample), with an overall mean of 12.7 years, ranging from 2-27 years' experience in the sport. Indeed, in compiling samples of alleged expert athletes, Abreu et al (2012) included performers with as little as *468* hours experience in their sport while Welch and Tschampl (2012) included athletes with a minimum of 24 months experience. Other definitions based on experience included *competitive experience* (*N*=8; M=9.69 years; Range = 4-20 years), although five of these did not specify which level of competition that was. Others reported *experience at elite level* (*N*=7; M=6.98 years; Range = 4 months-35years) or *international level* (*N*=2; M = 5.63 years; Range = 2-8years). Finally, experience of *elite training* (*N*=4; M = 5.71 years) was reported, as well as experience at *national level* (M = 13 years) and *games played for country*, which were both reported by one study each.

Professionalism. The third common definition was in regard to professionalism, reported by 27 studies (29.67% of the sample). Being *professional* athletes was the most-reported sub-category with 13 studies, while *playing in professional leagues* was also reported relatively frequently (*N*=12). The leagues involved ranged from top level for the sport in that country (e.g., Swedish Premier League in football - Ivarsson et al, 2013; top professional Spanish leagues for basketball, handball, roller hockey and indoor football – Mach et al, 2010) to second and third 'tier' (e.g., English Championship Division football - Morgan et al, 2013; B and C Italian series professional leagues in basketball - Abreu et al, 2012). Finally, *semi-professional* football/soccer and tennis players were also used in this definition (*N*=3), while one study reported athletes who received *commercial sponsorships*.

Training time/frequency. Elite/expert athletes were also defined in terms of the amount of training they completed, which was reported by 17 studies (18.68% of the sample). This training load was reported in terms of *daily* amount (*N*=2; M=6.5 hours/day) and *weekly duration* (*N*=12; M=13.1 hours; Range = 4-48 hours). *Weekly frequency* (*N*=6; M = 5.7 times/week; Range = 3-16 times) was also used, and some studies only employed athletes who trained at least 5 times a week (Babiloni et al, 2010; Bertello et al, 2012; Del Percio et al, 2011), or practiced 5-7 days a week (Ivarsson et al, 2013; LeCouteur & Feo, 2011).

Participation in elite talent development programmes. Eleven studies (12% of the sample) defined elite/expert athletes as those involved in talent development, or more specifically, *members of elite sport institutes/training centres* (*N*=7) or *national development programs* (*N*=3). One other study also used athletes in receipt of *athletic scholarships*. One example of this category was Carless and Douglas (2013) whose athletes were "registered on the UK Sport Council's athlete support program."

Regional level competition. Nine studies defined their elite/expert athletes as those competing at regional level, which equated to 15.4% of the sample. More specifically, five

studies referred to *regional* level, four used *state* level, and three referred to *provincial* level. It should be noted, though, that no samples exclusively used athletes at this standard, and instead they were included in larger samples of different sports and varying standards – possibly alluding to the use of these athletes on the grounds of convenience/ease of access.

Objective sport/country specific measures. Nine studies reported sport-specific definitions of elite/expert athletes (9.9% of the sample). The most common of these was *golf handicaps* (*N*=5; M = 0.44), ranging from -2 (Bernier & Fournier, 2010) to 10 (Beilock & Gray, 2012). Other measures used to define elite/expert athletes (and reported by one study each) included *black belt* in martial arts (Welch & Tschampl, 2012); triathletes' $V0_2$ peak scores (which ranged from 58.6-72.6mLkg^{-1} min^{-1}; Terry, Karageorghis, Mecozzi Saha & D'Auria, 2012); the French Rating Scale of Difficulty in climbing (vales from 7b1 to 8b where 7a or above was classed as elite; Sanchez, Boschker & Llewellyn, 2010); and athletes registered as elite on a ministerial list compiled by the French government (Demulier, Le Scanff & Stephan, 2013).

University level. Finally, elite/expert athletes were also defined as those competing at university level, and were reported by seven studies (7.69% of the sample). Specifically, three sub-categories reported: *NCAA Division 1* in America (*N*=1); *Varsity* athletes in America and Italy (*N*=2); *university students* (who also competed in certain sports; *N*=2); and those participating on *university teams* in China and Canada (*N*=2).

Additional Factors in Describing Elite/Expert Samples

Some studies claimed that their samples were distinct from other high-level athletes due to the amount of *success* that their athletes had achieved, for example, Macquet et al (2012) made the case that their participant had participated in the world orienteering championships for 14 years and had won gold seven times: "Based on this record, it is arguable that he is currently the world's best orienteer, and also one of the best ever" (p.93).

Similarly, Grant and Schempp's (2013) participants "totalled 24 gold, 6 silver, 5 bronze Olympic medals, and 55 world records, represent(ing) the most accomplished group of swimmers studied to date" (p.157). Thus researchers have suggested that identifying the best of the best involves extensive experience and repeated success at the highest level.

However, there also appears to be differences between sports that influence how well athletes can be compared to one another. For example, Storm et al (2012) referred to the differences between sports in terms of opportunities to progress: "we are aware of differences between the sports (involved) with regard to the athletes' opportunities to progress from national to international elite owing to the diverse prevalence and spread of their sport" (p.205). To illustrate, athletes from the most commonly-used sports in these samples (football/soccer, basketball, rowing, swimming) which have high participation rates are likely to have faced extensive competition in order to reach the highest level. Conversely, athletes from lesser-used sports (e.g., artistic roller-skating, windsurfing, adventure-racing, or roller hockey), which have lower participation rates, are likely to have faced less competition in their journey to the highest levels. Thus athletes from sports with higher participation rates could be at a relatively superior athletic standard, and it is important to consider the competitiveness of the sport in which such elite/expert athletes are involved.

It should be also noted that some studies defined their *non*-expert groups at higher standards than the *elite* groups in other studies. These included athletes who had competed at district to national level (Neil et al, 2011); while Hlldorsson et al (2012) employed "second-level athletes" as a control group, which consisted of four established Premier League teams in soccer, handball and basketball. Therefore it appears that there is inconsistency both in defining elite/expert athletes, but also between definitions of elite and *non-elite* athletes.

Generating Insights into the Nature of Expertise

At the outset, it seems reasonable to assume that research conducted on expert athletes should lead to general (i.e., domain-free) and logically warranted theoretical insights into the nature of expertise. In order to test the first part of this proposition, we analysed the results and discussion sections of the 91 empirical studies whose data had been obtained from samples of expert athletes. From this analysis, as Table 3 shows, it is evident that only 19 of these 91 studies (20.9%) contained authors' theoretical conclusions about the nature of sport expertise.

In order to assess the extent to which the authors' conclusions are warranted by the data that they collected, we examined the criteria used to define "expert" participants in each of the preceding 19 studies. In general, the stated conclusions appear to be logically valid because the vast majority of these 19 studies used conventional criteria (such as national/international representative honours to define expertise, e.g., Babiloni et al, 2010; Jowett & Spray, 2013). Nevertheless, one study defined expertise using a criterion of accumulated hours of practice which started with less than 500 hours – a figure that falls significantly below conventional criteria such as the 10 year rule (Gladwell, 2009) or the minimum requirement of 3000 hours proposed by Campitelli and Gobet (2011). Thus Abreu et al. (2012) reported that the expert basketball players in their study of action obeservation networks "had accumulated around 468-6,552 h of practice...since they had initated playing" (p. 1647). Unfortunately, the authors' subsequent conclusions about the existence of "an expertise-specific network" (p. 1653) are not tempered by any acknowledgement of the limitations of their criterion of expertise.

Justifying Expert Samples

To better understand the apparently limited value of the conclusions drawn in many of the studies, we analysed the reasons why they chose expert samples. We expected that the justification for studying elite athletes and the conclusions drawn from the research would be

related (i.e. where strong valid justifications existed, we expected to see novel and generalizable conclusions about expertise).

[INSERT TABLE 3 NEAR HERE]

The first and least important rationale for sampling experts was labelled *necessity* since the nature of the questions or phenomena these papers considered necessitated an expert sample. The majority of these studies – 13 of the 20 in this category – focused on the dysfunctional aspects of being an elite athlete, such as the eating disorders, doping, and burnout. Whilst these studies are important in terms of improving our understanding the dysfunctional aspects of elite athlete psychology, they do not develop new theoretical conclusions about the nature expertise, since it is not their purpose to do so. The only two papers in this category that did offer new theoretical insights (see Table 3) concerned optimal elite development pathways (Storm et al, 2012) and the effects of conscious thought on golf putting kinematics (Toner & Moran, 2011).

Of the 91 studies we analysed, the most common justification for sampling experts was *exploratory.* The studies drawing on this rationale (*N*=29) often contained a version of the phrase "little is known about *x*", signalling a gap in the research, often on a psychological phenomenon. Further analysis revealed that 20 of the 29 studies explored cognitive and psychological states and traits of experts that are otherwise well understood, such as attention and motivation. Six of the remaining studies explored the use of psychological skills by experts, such as imagery and goal setting, presumably with the intention of discovering repeatable best practice. In addition to the 29 exploratory studies, there were also a further 14 papers that contained no explicit rationale for sampling experts, though we suggest that many of these papers, too, were drawing on an implicit *exploratory* rationale. It was interesting to note that, despite the often-explicit goal of exploring hitherto unknown phenomena with

experts, only four of these 43 studies generated relevant theoretical conclusions about the nature of motor expertise (e.g., Bruce et al, 2013; Farrow et al, 2010; Jowett & Spray, 2013).

Conversely, the second largest group of studies explicitly set out to test hypotheses about the nature of expertise in sport. We labelled the rationale for these studies *superior* since they often assumed or theorized that experts are cognitively or psychologically superior to novices and sub-elite athletes, often with respect to perception, anticipation and decision-making. Within the sample of 32 papers containing this rationale, 17 explicitly attributed the hypothesized superiority to training, often making reference to 'deliberate practice' as the cause of heightened cognitive functioning. For example, Roca et al (2012) make explicit their view that "the amount and type of activities that elite soccer players engage in may provide some indication of the antecedents of expert performance" (p.1644). Given the dominance of the theory of deliberate practice in the field since the 1990s (Baker & Young, in press), it is perhaps unsurprising that only five of the papers attributed superiority to genetic traits or 'gifts', whilst another 10 studies made no attempt to explain the source of the athletes' assumed cognitive superiority. Unlike the *exploratory* papers, however, this category tended to make more explicit their theoretical conclusions about expertise. Approximately one third of the studies using the *superior* rationale (13 of 32) were considered to contain general novel insights into the nature of expertise in sport (see Table 3).

Discussion

Defining Elite/Expert Athletes

As expected, we found inconsistency. A wide range of definitions were identified, from Olympic gold medallists and world-record holders, to regional and university level athletes. These findings can be placed in context by exploring the suggestion that there are two types of samples which can be used when employing elite/expert athletes (Williams & Ford, 2008; Chi, 2006). The first has been termed the study of *absolute* expertise, or the

absolute approach (Chi, 2006), in which a small sample of truly exceptional athletes are studied with the intention of discovering how they perform successfully in their chosen sport. "This approach studies the remarkable few to understand how they are distinguished from the masses" (Chi, 2006, p.22). Alternatively, the *relative approach* involves comparison of experts to novices, and one group is defined relative to the other: "This *relative* approach assumes that expertise is a level of proficiency that novices can achieve...the goal is to understand how experts become that way so that others can learn to become more skilled and knowledgeable" (Chi, 2006, p.23). However as Williams and Ford (2008) acknowledged: "the disadvantage with this approach is that it fosters considerable variability in relation to the level of participants employed making it difficult to compare and synthesise findings across studies and sports" (p.12). We found evidence that experts may be international calibre athletes in one study, whereas in another they may be varsity performers or even lower. A similar problem exists with the classification of the novice group, and some non-expert groups were defined at a *higher* standard than elite/expert groups in other studies. While these assumptions may be relevant in other domains, it is perhaps not as possible to assume that novices will reach the same standards as experts in sport. For example, genetics *could* play a bigger role in sport than in other domains, evidenced by programmes such as Sporting Giants in the UK, which aimed to recruit athletes for the London 2012 Olympics rowing, handball, and volleyball teams (Sporting Giants, n.d.). This program sought individuals based on their age, height, and all-round sporting ability, but importantly, *no prior experience* in those sports was needed. Some of these athletes went on to win world championship medals, and even Olympic gold (Cullen, 2012). Furthermore, there are more objective criteria for judging expertise in sport than in other domains (e.g., Ericsson & Towne, 2013). Hence we argue that elite/expert athletes should be defined by *one* set of consistent, valid criteria rather than adopting the two approaches advocated by Chi (2006).

The definitions identified in the present study vary on a continuum of validity, with some athletes unquestionably elite, whilst others plainly were not. Specifically, our findings can be synthesised into three main themes to judge the validity of elite athletes *within* their sport, and two further themes which can be used to determine validity of sport expertise *across* sports. These themes are discussed below, while we also identify a number of the most problematic definitions used by researchers within the studies included in this review.

Athlete's highest standard of performance. Almost 70% of the included studies used athletes at performing at national and/or international level, implying that the athletes are at least among the best in their country at that sport. Furthermore, professional status was reported by almost 30% of the studies and also appeared to be a useful indicator of expertise in sport, that is, if the athlete is at a standard through which they can make a living from the sport. While both of these seem to be valid ways of defining elite athletes, it should also be noted that there are varying *levels* or 'tiers' for both. For example, competing at national/international level varies between amateur and professional levels (e.g., in golf; Bernier & Fournier, 2010); and even in professional sports there is often a top tier (e.g., Premier League in soccer; European Tour in golf), second-tier (e.g., Championship soccer in England; Challenge Tour in golf), third-tier (e.g., League 1 soccer in England; Alps Tour in golf), and even fourth-tier (e.g., League 2 in England). All of these involve professional athletes, yet vary considerably in terms of playing standard.

Athletes involved in talent development are by definition considered to have the potential to reach the highest standards in their sport. However, the important point is that it is still just *potential* – there is no guarantee that they will actually 'make it' to the highest level. Therefore it is difficult to suggest that these athletes are fully elite/expert. Similarly, athletes at regional level are not likely to be as proficient as those competing nationally or above, and it is more difficult to confidently class these athletes as elite or expert. Finally,

some NCAA Division 1 athletes at top sport universities in the USA which have a tradition of excelling in a certain sport could be argued to be relatively elite. However only one NCAA Division 1 sample was included in the studies reviewed, and even then, this sample included athletes who did not play regularly for the team (Ciana & Sheldon, 2010). Other samples included university students/teams from China, Italy and Canada which do not have systems that are as competitive as that in the USA, and therefore university-standard alone does not seem to be a particularly valid definition for elite athletes.

Success at the athlete's highest level. As well as performance standard, the athlete's level of success was also a valid indicator of their expertise. For example, nine samples of athletes who had won titles or medals, or who held records, at international level – six of which were in major international tournaments such as the Olympics or World Championships. National titles also suggest that the athlete has achieved a certain amount of success in their sport, and corresponding to the levels/tiers of performance standards described above, success at regional, university, or 4th tier level is likely to be the lowest validity of defining sport expertise.

Experience at athlete's highest level. The amount of experience the athlete had at *their* own highest level was a further indicator of eliteness, although not to the same extent as the two themes described above. For example, athletes who have competed at regional level for an extensive period of time should not be considered equal to those who have competed at the highest international level for a limited period of time. The mean experience at elite in the included studies was seven years, ranging from four months to 35 years. Thus, this continuum adds detail to the themes above.

Low-validity definitions. As well as the three themes described above, a number of questionable definitions emerged from the analyses. The most questionable definitions were those that did not provide detail of performance standard, and instead were more experience

or involvement based. Over 25% of the included studies described their samples in terms of the athletes' general experience within their sport. Some of these were as little as 24 months (Welch & Tschampl, 2012), minimum of 3 years and even 468 hours (Abreu et al, 2012) of involvement in a certain sport and seem highly questionable (e.g., in relation to the 'ten-year rule'; Hayes, 1985). While the overall mean of 12.7 years between these studies may exceed the 'ten-years rule,' it does not provide any indication of these athletes' standard of performance, and even suggests over-reliance on a misinterpretation of that rule. Indeed:

> (The) experience-based definition of expertise without a concurrent validation by observed superior performance was found to be problematic in the early 1990s...Most people know from firsthand experience that the number of times or amount of time a person has engaged in an everyday activity like...playing tennis...is not closely related to one's level of objective performance (Ericsson & Towne, 2013, p.887).

A similar critique applies to providing detail of the athletes' *competitive experience* without providing any indication of the standard of this competition (reported by five studies); and *training time/frequency* which provides an indication of the athlete's investment in their sport but also does not provide any indication of performance level either. Additionally, some performance-based definitions are questionable, for example semi-professional soccer players (Roca et al, 2012), and amateur golfers with handicaps ranging from -2 to 10. That is, some players averaged *ten* shots over par every time they play (Beilock & Gray, 2012). It can be confidently argued that such golfers are not elite. Finally, although the athlete's team may perform at a high level, this does not guarantee that all players will be at a similar standard. For example, in a sample of NCAA Division 1 athletes "two pitchers were used intermittently in the rotation, and one was a backup fielder that saw limited playing time" (Ciana & Sheldon, 2010, p. 129).

Competitiveness of the domain. As Ericsson and Towne (2013) suggested, "there are general characteristics...that mediate performance...depending on the competitiveness of the domain" (p.890). Furthermore, Storm et al (2012) noted differences in opportunities for athletes to progress to highest levels, depending on their sport. These ideas allude to issues when comparing athletes between sports, which is of particular relevance when studies use multi-sport samples. Indeed, dictionary definitions of the terms elite and expert refer to, for example, "a small group of people within a larger group who have more...talent than the rest of the group" (Encarta Dictionary). When defining elite or expert individuals, some comparison must be made with the rest of the population. For athletes, there are two main populations to which such comparisons are important: (i) the other athletes in that sport within their country; and (ii) the other athletes within that sport globally. These factors also have implications for the athletes' status as elite/expert, and the meaningfulness of these definitions.

Competition in the sport within the athlete's country. First, the relative status of an elite athlete could be judged by the pool of competition within their country, and the number of athletes they needed to compete against in order to reach national/international level. This comparison depends on the size of the country and the popularity of the sport within that country. For example, athletes from a country that has a prominent status in the sport (e.g., it is the national sport, such as soccer in Brazil) are likely to have faced much greater competition to reach the highest level, and are therefore likely to display an extremely high standard of performance. Alternatively, the sport may not be popular within that country, or the country may be a small sporting nation, so athletes are not likely to have developed comparable performance standards in order to reach the international level. As an extreme illustration, the swimmer Michael Phelps represented his country at the Olympic Games, as did 'Eric the Eel' from Equatorial Guinea!

Competition within the sport globally. Second, the relative status of an athlete could be judged by the global pool of competition within the sport that they are involved in, and the number of athletes they need to compete against in order to be considered the best in that sport. Regardless of the countries involved, this comparison depends on the global popularity of that sport and, consequently, competition structure and talent development systems. Highly developed, globally recognised sports with high participation rates in many different countries must be differentiated from sports that are less developed where only a small number of countries demonstrate high participation rates (or even no high participation rates in any country). To illustrate, extreme cases within the studies reviewed include soccer, basketball or swimming compared to roller-hockey, artistic roller-skating, and bowls.

Summary. The findings of this study are synthesised in Figure 1. Because of the wide range of studies and sports included, this could also be proposed as a model or heuristic device for classifying expert samples in sport. In turn, this could help researchers to define their samples along a continuum of 'eliteness' or expertise, in order to be transparent in their definitions, to encourage consistency within this field, and to improve understanding of expertise in sport.

[INSERT FIGURE 1 NEAR HERE]

To judge within the sport, definitions should be based on the athletes' highest standard of performance, their success at that level, and the amount of experience that they have gained *at that level*. To compare athletes across sports, it is vital that the competitiveness of the sport within the specific country, and within the sport itself, should both be considered. To capture these ideas, the following equation[2] and classification system is proposed:

[2] Because of our argument that experience is not as strong an indicator of expertise as performance standard or success, its value in this equation is halved.

‘Eliteness’/expertise of athletic sample = [(A + B + C/2)/3] x [(D + E)/2]

Classification: 1-4 = semi-elite; 4-8 = competitive elite; 8-12 = successful elite; 12-16 = world-class elite

Here, *semi-elite* athletes are those whose highest level of participation is below the top standard possible in their sport (e.g., in talent-development programs, competing at second-tier standard or below, etc.). *Competitive-elite* athletes regularly compete at the highest level in their sport (e.g., top divisions/leagues, or competing in the Olympic Games etc.) but have not had any success at that level. *Successful-elite* athletes not only compete at the highest level, but have experienced some (infrequent) success at that standard (e.g., winning an event or a medal). *World-class elite* athletes experience sustained success at the highest level, with repeated wins over a prolonged period of time (e.g., winning gold medals in consecutive Olympics, or major competitive victories over a number of seasons).

In comparison to previous definitions, this taxonomy appears to be more specific and potentially more useful in sport than those advocated previously. The *Cambridge Handbook of Expertise and Expert Performance* discusses dictionary definitions of experts (Ericsson, 2006, p.3-4), and “broad issues on attaining expert performance that generalise across different domains of expertise” (p.10) – however these are not specific to sport, and do not denote between the various ‘levels’ of expertise in this domain. Chi (2006) also included a proficiency scale ranging from novice to master (p.22), and although it does include various levels, this is not specific to sport (e.g., the highest level of proficiency – a master – is not applicable in sport as the ultimate goal is not to become a coach). Hodges, Starkes and MacMahon (2006), in a chapter devoted specifically to expert performance in sport, reinforced that: “It is very important in sport research to be specific and define the level of expertise/performance one is studying, both in terms of years of experience and also in level of competition and performance attained” (p.482) – but they did not define what those levels

are or could be. More recently, Gulbin and Weissensteiner (2013, p.56-58) discussed the FTEM (Foundations, Talent, Elite, Mastery) framework to guide the planning, review, and development of expertise pathways/systems. This framework identifies seven stages of sport excellence, including *breakthrough and reward* (e.g., national age-group representation), *representation* at senior national level, *success* in peak international competitions, and *sustained success* at the highest level. While these stages are more specific, the FTEM framework does not appear to account for between-sport comparisons (i.e., competitiveness of that sport in the athlete's country or globally), or the amount of experience the athlete has had at that level. Therefore, the taxonomy proposed in this review appears to be more comprehensive, specific, and practically useful than others available.

Justifying Samples and Generating Insights – a Kuhnian Perspective

Puzzle-solving with experts. As noted in Table 3, the most common rationale underlying selection of the sample (just less than half of the papers) was *exploratory*. It was alarming, therefore, that just 10% of the papers in this category generated novel and general theoretical conclusions about expertise, a reasonable expectation for studies claiming that 'little is known about' the phenomena they address. One way of interpreting this finding is to reflect on Thomas Kuhn's vision of scientific activity as 'puzzle-solving': the minute piecemeal extension of the reach of existing theories (or paradigms) by applying them in slightly different situations (Kuhn, 1996), such as exploring the goal-setting patterns of prospective Olympic athletes (Burton et al, 2010). This type of activity, though quite 'normal' according to Kuhn, is not to be confused with the genuine goal of science, which in this instance is to challenge, and therefore advance, our understanding of the cognitive or psychological basis of expertise in sport (Popper, 1959). To this extent, the scientific merit of the *exploratory* papers can reasonably be questioned.

The lack of an adequate nature/nurture debate. Although the papers drawing on the *superior* rationale were more successful in advancing our understanding of expertise in general (13 of the 32 studies), none engaged in the nature/nurture debate with respect to the source of expertise. 17 papers in this category made explicit claims about the causal relationship between 'deliberate practice' and expertise, whilst only five stated similar hypotheses with respect to genetic traits or cognitive structures. The other 10 papers in this category, though agreeing that experts posessess superior cognitive functioning, failed to offer an explanation as to the cause of this assumed superiority.

Although the role of deliberate practice in shaping expertise is undeniable, the issue of whether it is both *necessary and sufficient* for expertise is a more important (and debatable) question. For example, Tucker and Collins (2012) argued that "deliberate practice alone fails to account for the wide range of individual performance levels and responses to training observed in sport" (p. 556) and that expertise is not a simple outcome of accumulated hours of deliberate practice. Researchers have also concluded that we know little about the role of genetic differences in the acquisition of expertise (Campitelli & Gobet, 2011; Baker & Young, in press). Thus, we suggest that, if our knowledge about expertise is to be advanced, it is necessary for researchers to explain, in the first instance, how they believe expertise is developed. And, although it is admittedly difficult to pinpoint the necessary and sufficient conditions for the development of expertise (Moran, 2012), it is certainly a task worth undertaking. The lack of adequate debate in the recent literature therefore remains a serious oversight, especially given the importance of this debate for both talent identification and coaching.

Experts as idiosyncratic and dysfunctional? The studies that sampled experts based on *necessity* (e.g., Storm et al, 2012; Toner & Moran, 2011) often did so as a means to increase understanding of dysfunctional psychological behaviour in elite athletes. Whilst this

may be of little general interest to expertise researchers, it raises an interesting question for researchers who assume – at least implicitly – that experts are somehow superior, psychologically, to mere mortals (i.e., 32 of the papers in our sample). It has been suggested, for example, that elite sports men and women tend to 'overconform' to traditional sporting norms such as 'win at all costs', taking risks and 'playing through the pain', the single-minded dedication to a goal, and systematic bodily improvement, leading to dysfunctional or deviant behaviour (Hughes & Coakley, 2001). Overconforming to 'win at all costs', for example, may lead to doping (e.g., Lentillon-Kaestner et al, 2012). Similarly, taking risks and 'playing through the pain' may lead to injury and depression (e.g., Demulier et al., 2013); whilst striving for systematic bodily improvement can lead to eating disorders (e.g., Scoffier et al, 2012). It appears, then, that in addition to possessing almost super-human physical and cognitive expertise – abilities that are well worthy of study – experts are often rather idiosyncratic in their choice of psychological strategies in competitive settings and may be vulnerable to mental health issues. For example, the boundaries between athletes' pre-performance routines, superstitious beliefs and apparently obsessive-compulsive behaviour are frequently blurred.

More generally, there has been an upsurge of research interest in psychopathology among athletes (e.g., see Brewer & Petrie, 2014) – especially elite performers. Interestingly, epidemiological studies in this field have shown that certain kinds of psychopathology (e.g., eating disorders, depression) are more prevalent among elite athletes than in the general population or among less proficient performers. For example, prevalence rates for eating disorders such as anorexia nervosa and bulimia nervosa may be higher among collegiate and international elite athletes than in the general population (Brewer & Petrie, 2014). These problems are especially apparent in sports (e.g., gymnastics) in which weight and body size and shape are important. Similarly, Hammond et al. (2013) discovered that the prevalence of

depression among their sample of elite athletes (i.e., collegiate swimmers who were competing to represent Canada internationally) was higher than had been reported previously in the research literature. In particular, these authors reported that the prevalence of depression *doubled* among the top 25% of elite swimmers in their sample – especially after perceived performance failure. Clearly, elite athletes are far from the paragons of physical and mental health that they are often assumed to be. This state of affairs may be a consequence of the fact that elite athletes have to engage in prolonged and intensive training from an early age, often leaving their families at critically sensitive developmental stages in their lives (Bär & Markser, 2013). In short, we should not assume that the practices of experts are to be imitated.

Strengths and Limitations

We believe that the present systematic review has four main strengths. Firstly, it is based on rigorous selection criteria (see details in "Method" section) which enabled us to capture a broad range of recent empirical studies of expertise. Thus, reflecting the interdisciplinary nature of this field, we reviewed journal papers on expertise that were published not only in sport psychology but also in cognitive psychology, neuroscience, and in other relevant fields (e.g., motor learning) . Secondly, in exploring the question of how to define the construct of expertise, we addressed a crucial but unresolved issue in this field. Surprisingly, whereas many reviews (e.g., Williams & Ford, 2008) have examined research findings on expert-novice diferences in sport, there has been no evaluation to date of the adequacy of the operational definitions of expertise in the relevant research literature. Without clear agreement about how to define and/or classify expertise objectively in sport, the future of the field is bleak because a question mark hangs over the validity and generalizability of research findings on expert-novice differences. Thirdly, our review has led us to postulate a classification system which distinguishes between four types of elite

performer – semi-elite, competitive-elite, successful-elite, and world-class elite athletes (see earlier for details). This classification system is not intended to be definitive – but merely an heuristic device to encourage expertise researchers to think carefully before selecting their samples. Finally, in questioning prevailing assumptions about the *meaning* of expertise, we also questioned certain assumed characteristics (e.g., invulnerability to mental health issues) of expert athletes.

Balanced against these strengths, however, we acknowledge several limitations of our paper as follows. To begin with, although our aim was to evaluate the most recent (since 2010) research on expertise, we had to exclude a large number of studies because they had used different definitions of expertise from those that we employed (e.g., "skilled" and "unskilled"). Secondly, we were forced to reject from consideration some studies that had sampled athletes who were obviously at the elite level (e.g., World or Olympic champions), but who were not *explicitly* defined as "elite" or "expert" in the title or abstract of the relevant journal paper. Thirdly, our taxonomy of expertise is based only on the data from the *included* studies - so it needs to be refined by future empirical investigations. A related limitation is that, at present, our taxonomy does not easily enable classification of multi-sport samples which is one immediate avenue for future research.

Conclusion

As expertise research is an imposing edifice with many different rooms, it is all too easy to forget that its foundations need to be checked from time to time. In conducting this systematic review of the operational definition of "expertise", we seek to open, not close, scientific debate. So, the framework postulated in Figure 1 is intended as a modest proposal or 'tentative solution' (Popper, 1959) to the problem of how to select a valid sample of experts for future research. In a bid to test this bold conjecture, we invite empirical refinement from future scholars in the hope that we can move towards a valid and reliable

method of sampling athletes for research that is most likely to advance our theoretical understanding of the phenomenon of expertise in sport. Such research, as we have shown, will also have greater explanatory power if researchers are able to offer and then test specific hypotheses about the *sources* of expertise - whether genetic or the result of specific modes, frequencies and intensities of deliberate practice.

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Tables

Table 1

Journals in which the Included Studies were Published.

	Journal Name	Number of Articles	Percentage of sample
Sport Journals	Psychology of Sport and Exercise	25	27.47%
	Journal of Applied Sport Psychology	12	13.19%
	International Journal of Sport Psychology	7	7.69%
	The Sport Psychologist	6	6.59%
	Scandinavian Journal of Medicine & Science in Sports	5	5.49%
	Journal of Sport and Exercise Psychology	4	4.39%
	Journal of Sport Sciences	4	4.39%
	Journal of Science and Medicine in Sport	3	3.29%
	International Journal of Sport Science and Coaching	2	2.2%
	Research Quarterly for Exercise and Sport	2	2.2%
	Clinical Journal of Sport Medicine	1	1.1%
	Medicine & Science in Sports & Exercise	1	1.1%
Non-Sport Journals	Neuroscience	2	2.2%
	Perceptual & Motor Skills	2	2.2%
	PLoS ONE	2	2.2%
	Acta Psychologica	1	1.1%
	Anxiety, Stress and Coping	1	1.1%
	Behavioural Brain Research	1	1.1%
	European Journal of Neuroscience	1	1.1%
	Experimental Psychology	1	1.1%
	Human Movement Science	1	1.1%
	Journal of Applied Social Psychology	1	1.1%
	Journal of Occupational and Organisational Psychology	1	1.1%
	Journal of Sport Rehabilitation	1	1.1%
	Memory & Cognition	1	1.1%
	Personality and Mental Health	1	1.1%
	Psychology of Music	1	1.1%
	The Quarterly Journal of Experimental Psychology	1	1.1%
Total	28 Journals	91	

Table 2

Definitions Provided for Elite/Expert Athletes, with Number (N) and Percentage (%) of Included Studies Reporting Each

Categories	*N*	%	Sub-categories	*N*	%	Mean	Range
International and/or national level	63	69.23	Medals, titles or records at major international competitions	6	6.59		
			International medals, records or titles	3	3.3		
			World class	2	2.2		
			Participate in major international competitions	10	10.99		
			International level	13	14.29		
			Prospective Olympians	2	2.2		
			Competing at international and/or national level	14	15.38		
			Represent country/national team	25	27.47		
			National titles	1	1.1		
			National level	12	13.19		
			Participation in national leagues	5	5.49		
Experience	45	49.45	In general	24	26.37	12.7 yrs	2-27 yrs
			Competitive	8	8.79	9.69 yrs	4-20 yrs
			At elite level	7	7.69	6.98 yrs	4months-35 yrs
			Elite training	4	4.4	5.71 yrs	
			At international level	2	2.2	5.63 yrs	2-8 yrs
			At national level	1	1.1	13 yrs	
			Games played for country	1	1.1		
Professionalism	27	29.67	Professional	12	13.19		
			Playing in professional leagues	12	13.19		
			Semi-professional	3	3.3		
			Commercial sponsorships	1	1.1		
Training	17	18.68	Daily	1	1.1	6.54 hr	
			Weekly duration	12	13.19	13.08 hr	4-48 hours
			Weekly frequency	6	6.59	5.68times	3-16 times
Involved in talent development	11	12.09	Members of elite sport institutes/training centres	7	7.69		
			National development programs	3	3.3		
			Athletic scholarships	1	1.1		
Regional level	9	9.89	Regional level	5	5.49		
			State	4	4.4		
			Provincial	3	3.3		
Sport/country-specific measures	9	9.89	Golf handicaps	5	5.49	0.44	-2 to 10
			Black belt	1	1.1		
			Vo2 peak scores	1	1.1		
			French Rating Scale of Difficulty	1	1.1		
			Ministerial list compiled by government	1	1.1		
University	7	7.69	NCAA Div1	1	1.1		
			Varsity	2	2.2		
			University teams	2	2.2		
			University students	2	2.2		

Note. Some papers included multi-faceted definitions which spanned more than one of these categories.

Table 3

Rationales for Sampling Experts and Studies Drawing Theoretical Conclusions about Expertise in Sport

Category of rationale		Description of rationale	*N* (%) of papers using rationale	Papers containing general theoretical conclusions about motor expertise
None		No explicit rationale offered. Tacit exploratory in most.	14 (15.38%)	Farrow et al (2010)
Exploratory		Normally begin with the classic refrain: "little is known about…" then explain that a well-understood psychological phenomena needs to be explored with elite or expert athletes. There is an assumption that experts are likely to display markedly different psychological traits or practices compared to novices, and that novices can learn something from experts.	29 (31.86%)	Bruce et al (2013); Jowett & Spray (2013); Macquet et al (2012)
Necessity		The nature of the question dictates that elite performers are sampled. This is often the case where the phenomenon (doping, career-threatening injury, retirement from sport career) may only apply to elite performers.	20 (21.97%)	Storm et al (2012); Toner & Moran (2011)
Superior	Training	These studies specifically aim to test hypotheses that experts will perform better at certain cognitive and motor tasks due to extended and superior training (or 'deliberate practice').	17 (18.68%)	Babiloni et al (2010); Gorman et al (2012); Güldenpenning et al (2012); Moreau et al (2011); Tomasino et al (2012); Wei & Luo (2010); Wei et al (2011)
	Brain	These studies specifically aim to test hypotheses that experts will perform better at certain cognitive and motor tasks due to the possession of traits that are inherited or developed outside of training.	5 (5.49%)	Paulus et al (2012); Wu et al (2013)
	Unexplained	Experts are assumed to function at a higher cognitive or psychological level but there is no explanation as to why this may be the case.	10 (10.99%)	Abreu et al (2012); Del Percio et al (2011); Lorains et al (2013); Weigelt et al (2011)
TOTAL (some papers have more than one rationale)			**95**	

Figure 1

Summary of Findings and Model for Classifying the Validity of Expert Samples in Sport Psychology Research

Variable/score	1	2	3	4	
A. Athlete's highest standard of performance	Regional level; university level; semi-professional; 4th tier leagues or tours	Involved in talent development; 3rd tier professional leagues or tours	National level; selected to represent nation; 2nd tier professional leagues or tours	International level; top tier professional leagues or tours	**Within-sport comparison**
B. Success at the athlete's highest level	Success at regional, university, semi-professional, or 3rd/4th tier	National titles or success at 2nd/3rd tier	Infrequent success at international level or top tier	Sustained success in major international, globally recognised competition	
C. Experience at the athlete's highest level	<2 years	2-5 years	5-8 years	8+ years	
D. Competitiveness of sport in athlete's country	Sport ranks outside top 10 in county; small sporting nation	Sport ranks 5-10 in country; small-medium sporting nation	Sport ranks top 5 in country; medium-large sporting nation	National sport; large sporting nation	**Between-sports comparison**
E. Global competitiveness of sport	Not Olympic sport; World championships limited to few countries; limited national TV audience	Occasional Olympic sport; World championships limited to a few counties; limited international TV audience	Recent Olympic sport with regular international competition; semi-global TV audience	Regular Olympic sport with frequent major international competition; global TV audience	