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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, Academic Search Complete, PsycINFO, and PsycARTICLES 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, psychology, sport, performance, elite, expert, defining, study, issues

Disciplines

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Running Head: DEFINING ELITE/EXPERT ATHLETES

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

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19 19 of the 91 included studies provided conclusions about the nature of expertise in sport.

20 **Conclusions:** This study suggests that the definitions of elite athletes vary on a continuum of
21 validity, and the findings are translated into a taxonomy for classifying expert samples in
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24

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

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

2 Whether out of envy or admiration, we have long been fascinated by the breath-taking
3 feats of expert or “elite”¹ athletes, such as the footballer Lionel Messi or the tennis star Rafael
4 Nadal, who can perform apparently impossible skills with remarkable consistency and
5 precision. In an effort to understand the cognitive and neural processes that underlie such
6 exceptional skills, researchers in disciplines such as cognitive psychology, sport psychology,
7 motor learning/skill acquisition, kinesiology and neuroscience have developed a field of
8 inter-disciplinary inquiry that is concerned with the scientific study of ‘expertise’ or the
9 growth of specialist knowledge and skills through effortful experience (see Ericsson, 1996,
10 for a detailed introduction). Although empirical research on expertise is little more than four
11 decades old, psychological speculation about the nature and determinants of eminence in
12 human achievement dates back at least as far as Galton (1869). Interestingly, whereas the first
13 modern studies in this field (in the 1960s and 1970s) were conducted mainly on performance
14 in formal knowledge domains such chess (e.g., see de Groot, 1965; Chase & Simon, 1973),
15 more recent research (since the mid-1990s) has explored expert-novice differences in largely
16 perceptual-motor domains such as dance (Bläsing et al., 2012) and sport (e.g., Müller et al.,
17 2010; Williams & Ford, 2008). Regardless of the domain under investigation, however,
18 research on expertise is now a “hot topic” in psychology. To illustrate this trend, expertise
19 has attracted distinctive methodological paradigms (e.g., Ericsson, 2013; Ericsson & Ward,
20 2007); special issues of academic journals such as *Applied Cognitive Psychology* (Ericsson,
21 2005), *Journal of Experimental Psychology: Applied* (Ericsson & Williams, 2007) and
22 *Journal of Sport & Exercise Psychology* (Williams & Ericsson, 2008); several scholarly
23 handbooks (e.g., Ericsson et al., 1996; Staszewski, 2013); and considerable interest from
24 popular science writers (e.g., Colvin, 2008; Gladwell, 2009; Syed, 2010). Arising from this

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

1 confluence of research activity, evidence has accumulated to show that expert athletes differ
2 consistently from relative novices with regard to a variety of perceptual, cognitive and
3 strategic aspects of behaviour (see summary in Eklund & Tenenbaum, 2014). For example,
4 compared to their novice counterparts, expert athletes tend to have a more extensive
5 knowledge-base of sport-specific information and to be more adept at using this knowledge
6 efficiently to identify, remember and manipulate relevant information in their specialist sport.
7 To summarise, on the basis of the preceding evidence, it seems reasonable to conclude that
8 research on expertise is a thriving and productive scientific endeavour.

9 Unfortunately, this latter conclusion may be challenged on the grounds that there is
10 considerable confusion and inconsistency among expertise researchers with regard to the
11 criteria used to define the term “elite” or “expert” athlete (Polman, 2012). For example,
12 despite widespread acceptance of the “ten year rule” (Hayes, 1985) – or the assumption that it
13 takes about 10 years of sustained deliberate practice to become an expert in any field or
14 10,000 hours (as popularised by Gladwell, 2009) – the terms “elite” and “expert” have been
15 ascribed to athletes with as little as *two years* of accumulated practice (e.g., Welch &
16 Tschampl, 2012). Similarly, they have been applied in a rather cavalier fashion to such
17 heterogeneous samples as Olympic champions (e.g., Grant & Schempp, 2013), professional
18 performers (Jordet & Elferink-Gemser, 2012), inter-varsity athletes (e.g., Steiner et al, 2010),
19 members of national squads (Bertello et al, 2012), and athletes who were simply part of a
20 competitive team (Voss et al, 2010). Clearly, such imprecision in the criteria used to define
21 participants as “expert” athletes threatens the validity of research on expertise in sport. For
22 example, at a theoretical level, it is difficult to draw valid conclusions about expertise from
23 studies in which experts have been defined using significantly different criteria.
24 Unfortunately, the extent of this definitional problem at the heart of expertise research has not

1 number of irrelevant terms that were designated as ‘limiters’ to be removed them from the
2 final results. The list of search terms employed was:

3 (elite OR expert*) AND athlet* AND sport AND (psychology OR neuroscience)

4 NOT (adolescent OR youth OR junior OR review)

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

8 **Inclusion/Exclusion Criteria**

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

1 **Search Returns**

2 The search process was finalised on the 14th of September, 2013, and initially returned
3 731 potentially relevant studies. After duplicates and studies not published in English were
4 removed, the titles and abstracts of the remaining potential targets were assessed for
5 relevance. This step reduced the potential target papers to 240 articles. Another 80 papers
6 were removed because they were not published in journals with an impact factor. Full-text
7 copies were then obtained for the remaining 160 studies, after which a further 69 were
8 excluded either because: (a) they stated in-text that they used young/junior athletes; (b) they
9 were not sufficiently focused on psychology; or (c) they did not explicitly describe their
10 sample as elite or expert (e.g., some mentioned ‘expertise’ in the abstract but referred to their
11 sample as ‘skilled’ or ‘experienced’ instead). In total, 91 studies published in 28 different
12 journals met the inclusion criteria (as described in Table 1). All of the current paper’s authors
13 were involved in the process of determining which studies should be included. In cases where
14 studies did not clearly meet criteria, discussions took place until all authors agreed on how to
15 proceed (i.e., either by including or excluding the studies in question).

16 **[INSERT TABLE 1 NEAR HERE]**

17 **Data Extraction and Synthesis**

18 Once the final 91 studies had been identified, the relevant sections in each were
19 repeatedly read by the lead researcher (first author) in order to become familiar with, and
20 immersed in, the data to fully appreciate its significance (see Maykut & Morehouse’s [1994]
21 concept of *indwelling*). Data pertaining to the three main research questions were extracted
22 by the first and third authors, and included in an audit trail which was verified by all authors
23 (e.g., by processes of peer debrief and investigator triangulation; see below). As the data were
24 primarily qualitative, a process of thematic analysis was used to identify, group, and
25 summarise the most relevant issues/themes emerging from the included studies (Pope, Mays,

1 & Popay, 2007). A team approach to analysis was adopted whereby each of the authors was
2 presented with the table of extracted data and separately analysed it before offering critical
3 feedback and reaching agreement on the results (e.g., key themes that emerged).

4 **Reliability/Trustworthiness**

5 Since qualitative analysis procedures were used to categorise the data (i.e., see
6 thematic analysis; Braun & Clarke, 2006), a number of processes were followed in order to
7 enhance the trustworthiness, quality, and rigour of our work (Seale, 1999; Sparkes & Smith,
8 2009). The issue of reliability was addressed by attempting to achieve consensus in article
9 inclusion, as well as during data extraction and data coding. To facilitate researcher
10 triangulation, peer debrief (e.g., Creswell & Miller, 2000; Lincoln & Guba, 1985) was also
11 employed. This process took place between the lead researcher (first author) and the second
12 and third authors who provided guidance on the process of conducting the review, and on
13 research on expertise in sport. Peer debrief took place throughout this study, by way of
14 regular formal meetings and informal discussions. Finally, the audit trail discussed above was
15 created and checked by all three authors to enhance transparency. This document is available
16 on request from the first author.

17 **Results**

18 **General Findings**

19 The 91 papers included in this review comprised a total population size of 8572
20 elite/expert athletes, made up of 3482 males (40.6%) and 2598 females (30.3%) – the
21 remaining 29.1% of the sample were in studies which did not denote the sex of their athletes.
22 101 independent samples were included as some papers reported more than one study.
23 However no athletes were used twice in the samples in these studies. Overall, 59 studies
24 employed whole samples from one single sport, whereas 28 studies used multi-sport samples,
25 and four did not describe which sports their athletes competed in. The most frequently-

1 sampled sports were football/soccer ($N=16$), swimming ($N=16$), basketball ($N=14$), and
2 rowing ($N=12$). By contrast, the least frequently-sampled sports included mountain running,
3 adventure racing, roller hockey, artistic roller-skating, windsurfing, and bowls (all $N=1$). In
4 the case of 13 studies, the whole sample was not used because they included athletes who did
5 not meet the inclusion/exclusion criteria (e.g., they were novices). In these latter cases, we
6 used details for the expert athletes only.

7 **Definitions of Elite/Expert Athletes**

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

20 **[INSERT TABLE 2 NEAR HERE]**

21 **International and/or national competitive level.** This theme was reported most
22 often by the studies, with 61 (67% of the sample) defining elite/expert athletes as those
23 competing at international and/or national level. It was difficult to separate international and
24 national level (e.g., due to studies reporting themes such as *competing at international and/or*
25 *national level*; $N=14$), while other athletes who *represent their country or national team*

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

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

24 **Professionalism.** The third common definition was in regard to professionalism,
25 reported by 27 studies (29.67% of the sample). Being *professional* athletes was the most-

1 reported sub-category with 13 studies, while *playing in professional leagues* was also
2 reported relatively frequently ($N=12$). The leagues involved ranged from top level for the
3 sport in that country (e.g., Swedish Premier League in football - Ivarsson et al, 2013; top
4 professional Spanish leagues for basketball, handball, roller hockey and indoor football –
5 Mach et al, 2010) to second and third ‘tier’ (e.g., English Championship Division football -
6 Morgan et al, 2013; B and C Italian series professional leagues in basketball - Abreu et al,
7 2012). Finally, *semi-professional* football/soccer and tennis players were also used in this
8 definition ($N=3$), while one study reported athletes who received *commercial sponsorships*.

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

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

22 **Regional level competition.** Nine studies defined their elite/expert athletes as those
23 competing at regional level, which equated to 15.4% of the sample. More specifically, five
24 studies referred to *regional* level, four used *state* level, and three referred to *provincial* level.
25 It should be noted, though, that no samples exclusively used athletes at this standard, and

1 instead they were included in larger samples of different sports and varying standards –
2 possibly alluding to the use of these athletes on the grounds of convenience/ease of access.

3 **Objective sport/country specific measures.** Nine studies reported sport-specific
4 definitions of elite/expert athletes (9.9% of the sample). The most common of these was *golf*
5 *handicaps* ($N=5$; $M = 0.44$), ranging from -2 (Bernier & Fournier, 2010) to 10 (Beilock &
6 Gray, 2012). Other measures used to define elite/expert athletes (and reported by one study
7 each) included *black belt* in martial arts (Welch & Tschampl, 2012); triathletes' $\dot{V}O_2$ peak
8 scores (which ranged from 58.6-72.6 mL kg⁻¹ min⁻¹; Terry, Karageorghis, Mecozzi Saha &
9 D'Auria, 2012); the French Rating Scale of Difficulty in climbing (values from 7b1 to 8b
10 where 7a or above was classed as elite; Sanchez, Boschker & Llewellyn, 2010); and athletes
11 registered as elite on a ministerial list compiled by the French government (Demulier, Le
12 Scanff & Stephan, 2013).

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

18 **Additional Factors in Describing Elite/Expert Samples**

19 Some studies claimed that their samples were distinct from other high-level athletes
20 due to the amount of *success* that their athletes had achieved, for example, Macquet et al
21 (2012) made the case that their participant had participated in the world orienteering
22 championships for 14 years and had won gold seven times: “Based on this record, it is
23 arguable that he is currently the world’s best orienteer, and also one of the best ever” (p.93).
24 Similarly, Grant and Schempp’s (2013) participants “totalled 24 gold, 6 silver, 5 bronze
25 Olympic medals, and 55 world records, represent(ing) the most accomplished group of

1 swimmers studied to date” (p.157). Thus researchers have suggested that identifying the best
2 of the best involves extensive experience and repeated success at the highest level.

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

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

22 **Generating Insights into the Nature of Expertise**

23 At the outset, it seems reasonable to assume that research conducted on expert athletes
24 should lead to general (i.e., domain-free) and logically warranted theoretical insights into the
25 nature of expertise. In order to test the first part of this proposition, we analysed the results

1 and discussion sections of the 91 empirical studies whose data had been obtained from
2 samples of expert athletes. From this analysis, as Table 3 shows, it is evident that only 19 of
3 these 91 studies (20.9%) contained authors' theoretical conclusions about the nature of sport
4 expertise.

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

19 **Justifying Expert Samples**

20 To better understand the apparently limited value of the conclusions drawn in many of
21 the studies, we analysed the reasons why they chose expert samples. We expected that the
22 justification for studying elite athletes and the conclusions drawn from the research would be
23 related (i.e. where strong valid justifications existed, we expected to see novel and
24 generalizable conclusions about expertise).

25 **[INSERT TABLE 3 NEAR HERE]**

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

11 Of the 91 studies we analysed, the most common justification for sampling experts
12 was *exploratory*. The studies drawing on this rationale ($N=29$) often contained a version of
13 the phrase “little is known about x ”, signalling a gap in the research, often on a psychological
14 phenomenon. Further analysis revealed that 20 of the 29 studies explored cognitive and
15 psychological states and traits of experts that are otherwise well understood, such as attention
16 and motivation. Six of the remaining studies explored the use of psychological skills by
17 experts, such as imagery and goal setting, presumably with the intention of discovering
18 repeatable best practice. In addition to the 29 exploratory studies, there were also a further 14
19 papers that contained no explicit rationale for sampling experts, though we suggest that many
20 of these papers, too, were drawing on an implicit *exploratory* rationale. It was interesting to
21 note that, despite the often-explicit goal of exploring hitherto unknown phenomena with
22 experts, only four of these 43 studies generated relevant theoretical conclusions about the
23 nature of motor expertise (e.g., Bruce et al, 2013; Farrow et al, 2010; Jowett & Spray, 2013).

24 Conversely, the second largest group of studies explicitly set out to test hypotheses
25 about the nature of expertise in sport. We labelled the rationale for these studies *superior*

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

15 Discussion

16 Defining Elite/Expert Athletes

17 As expected, we found inconsistency. A wide range of definitions were identified,
18 from Olympic gold medallists and world-record holders, to regional and university level
19 athletes. These findings can be placed in context by exploring the suggestion that there are
20 two types of samples which can be used when employing elite/expert athletes (Williams &
21 Ford, 2008; Chi, 2006). The first has been termed the study of *absolute* expertise, or the
22 *absolute approach* (Chi, 2006), in which a small sample of truly exceptional athletes are
23 studied with the intention of discovering how they perform successfully in their chosen sport.
24 “This approach studies the remarkable few to understand how they are distinguished from the
25 masses” (Chi, 2006, p.22). Alternatively, the *relative approach* involves comparison of

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

22 The definitions identified in the present study vary on a continuum of validity, with
23 some athletes unquestionably elite, whilst others plainly were not. Specifically, our findings
24 can be synthesised into three main themes to judge the validity of elite athletes *within* their
25 sport, and two further themes which can be used to determine validity of sport expertise

1 *across* sports. These themes are discussed below, while we also identify a number of the most
2 problematic definitions used by researchers within the studies included in this review.

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

16 Athletes involved in talent development are by definition considered to have the
17 potential to reach the highest standards in their sport. However, the important point is that it
18 is still just *potential* – there is no guarantee that they will actually 'make it' to the highest
19 level. Therefore it is difficult to suggest that these athletes are fully elite/expert. Similarly,
20 athletes at regional level are not likely to be as proficient as those competing nationally or
21 above, and it is more difficult to confidently class these athletes as elite or expert. Finally,
22 some NCAA Division 1 athletes at top sport universities in the USA which have a tradition of
23 excelling in a certain sport could be argued to be relatively elite. However only one NCAA
24 Division 1 sample was included in the studies reviewed, and even then, this sample included
25 athletes who did not play regularly for the team (Ciana & Sheldon, 2010). Other samples

1 included university students/teams from China, Italy and Canada which do not have systems
2 that are as competitive as that in the USA, and therefore university-standard alone does not
3 seem to be a particularly valid definition for elite athletes.

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

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

19 **Low-validity definitions.** As well as the three themes described above, a number of
20 questionable definitions emerged from the analyses. The most questionable definitions were
21 those that did not provide detail of performance standard, and instead were more experience
22 or involvement based. Over 25% of the included studies described their samples in terms of
23 the athletes' general experience within their sport. Some of these were as little as 24 months
24 (Welch & Tschampl, 2012), minimum of 3 years and even 468 hours (Abreu et al, 2012) of
25 involvement in a certain sport and seem highly questionable (e.g., in relation to the 'ten-year

1 rule'; Hayes, 1985). While the overall mean of 12.7 years between these studies may exceed
2 the 'ten-years rule,' it does not provide any indication of these athletes' standard of
3 performance, and even suggests over-reliance on a misinterpretation of that rule. Indeed:

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

9 A similar critique applies to providing detail of the athletes' *competitive experience*
10 without providing any indication of the standard of this competition (reported by five
11 studies); and *training time/frequency* which provides an indication of the athlete's investment
12 in their sport but also does not provide any indication of performance level either.

13 Additionally, some performance-based definitions are questionable, for example semi-
14 professional soccer players (Roca et al, 2012), and amateur golfers with handicaps ranging
15 from -2 to 10. That is, some players averaged *ten* shots over par every time they play
16 (Beilock & Gray, 2012). It can be confidently argued that such golfers are not elite. Finally,
17 although the athlete's team may perform at a high level, this does not guarantee that all
18 players will be at a similar standard. For example, in a sample of NCAA Division 1 athletes
19 "two pitchers were used intermittently in the rotation, and one was a backup fielder that saw
20 limited playing time" (Ciana & Sheldon, 2010, p. 129).

21 **Competitiveness of the domain.** As Ericsson and Towne (2013) suggested, "there
22 are general characteristics...that mediate performance...depending on the competitiveness of
23 the domain" (p.890). Furthermore, Storm et al (2012) noted differences in opportunities for
24 athletes to progress to highest levels, depending on their sport. These ideas allude to issues
25 when comparing athletes between sports, which is of particular relevance when studies use

1 multi-sport samples. Indeed, dictionary definitions of the terms elite and expert refer to, for
2 example, “a small group of people within a larger group who have more...talent than the rest
3 of the group” (Encarta Dictionary). When defining elite or expert individuals, some
4 comparison must be made with the rest of the population. For athletes, there are two main
5 populations to which such comparisons are important: (i) the other athletes in that sport
6 within their country; and (ii) the other athletes within that sport globally. These factors also
7 have implications for the athletes’ status as elite/expert, and the meaningfulness of these
8 definitions.

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

21 ***Competition within the sport globally.*** Second, the relative status of an athlete could
22 be judged by the global pool of competition within the sport that they are involved in, and the
23 number of athletes they need to compete against in order to be considered the best in that
24 sport. Regardless of the countries involved, this comparison depends on the global popularity
25 of that sport and, consequently, competition structure and talent development systems. Highly

1 developed, globally recognised sports with high participation rates in many different
 2 countries must be differentiated from sports that are less developed where only a small
 3 number of countries demonstrate high participation rates (or even no high participation rates
 4 in any country). To illustrate, extreme cases within the studies reviewed include soccer,
 5 basketball or swimming compared to roller-hockey, artistic roller-skating, and bowls.

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

12 **[INSERT FIGURE 1 NEAR HERE]**

13 To judge within the sport, definitions should be based on the athletes’ highest
 14 standard of performance, their success at that level, and the amount of experience that they
 15 have gained *at that level*. To compare athletes across sports, it is vital that the
 16 competitiveness of the sport within the specific country, and within the sport itself, should
 17 both be considered. To capture these ideas, the following equation² and classification system
 18 is proposed:

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

20 Classification: 1-4 = semi-elite; 4-8 = competitive elite; 8-12 = successful elite;

21 12-16 = world-class elite

22 Here, *semi-elite* athletes are those whose highest level of participation is below the top
 23 standard possible in their sport (e.g., in talent-development programs, competing at second-

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.

1 tier standard or below, etc.). *Competitive-elite* athletes regularly compete at the highest level
2 in their sport (e.g., top divisions/leagues, or competing in the Olympic Games etc.) but have
3 not had any success at that level. *Successful-elite* athletes not only compete at the highest
4 level, but have experienced some (infrequent) success at that standard (e.g., winning an event
5 or a medal). *World-class elite* athletes experience sustained success at the highest level, with
6 repeated wins over a prolonged period of time (e.g., winning gold medals in consecutive
7 Olympics, or major competitive victories over a number of seasons).

8 In comparison to previous definitions, this taxonomy appears to be more specific and
9 potentially more useful in sport than those advocated previously. The *Cambridge Handbook*
10 *of Expertise and Expert Performance* discusses dictionary definitions of experts (Ericsson,
11 2006, p.3-4), and “broad issues on attaining expert performance that generalise across
12 different domains of expertise” (p.10) – however these are not specific to sport, and do not
13 denote between the various ‘levels’ of expertise in this domain. Chi (2006) also included a
14 proficiency scale ranging from novice to master (p.22), and although it does include various
15 levels, this is not specific to sport (e.g., the highest level of proficiency – a master – is not
16 applicable in sport as the ultimate goal is not to become a coach). Hodges, Starkes and
17 MacMahon (2006), in a chapter devoted specifically to expert performance in sport,
18 reinforced that: “It is very important in sport research to be specific and define the level of
19 expertise/performance one is studying, both in terms of years of experience and also in level
20 of competition and performance attained” (p.482) – but they did not define what those levels
21 are or could be. More recently, Gulbin and Weissensteiner (2013, p.56-58) discussed the
22 FTEM (Foundations, Talent, Elite, Mastery) framework to guide the planning, review, and
23 development of expertise pathways/systems. This framework identifies seven stages of sport
24 excellence, including *breakthrough and reward* (e.g., national age-group representation),
25 *representation* at senior national level, *success* in peak international competitions, and

1 *sustained success* at the highest level. While these stages are more specific, the FTEM
2 framework does not appear to account for between-sport comparisons (i.e., competitiveness
3 of that sport in the athlete's country or globally), or the amount of experience the athlete has
4 had at that level. Therefore, the taxonomy proposed in this review appears to be more
5 comprehensive, specific, and practically useful than others available.

6 **Justifying Samples and Generating Insights – a Kuhnian Perspective**

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

20 **The lack of an adequate nature/nurture debate.** Although the papers drawing on
21 the *superior* rationale were more successful in advancing our understanding of expertise in
22 general (13 of the 32 studies), none engaged in the nature/nurture debate with respect to the
23 source of expertise. 17 papers in this category made explicit claims about the causal
24 relationship between 'deliberate practice' and expertise, whilst only five stated similar
25 hypotheses with respect to genetic traits or cognitive structures. The other 10 papers in this

1 category, though agreeing that experts possess superior cognitive functioning, failed to
2 offer an explanation as to the cause of this assumed superiority.

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

17 **Experts as idiosyncratic and dysfunctional?** The studies that sampled experts based
18 on *necessity* (e.g., Storm et al, 2012; Toner & Moran, 2011) often did so as a means to
19 increase understanding of dysfunctional psychological behaviour in elite athletes. Whilst this
20 may be of little general interest to expertise researchers, it raises an interesting question for
21 researchers who assume – at least implicitly – that experts are somehow superior,
22 psychologically, to mere mortals (i.e., 32 of the papers in our sample). It has been suggested,
23 for example, that elite sports men and women tend to ‘overconform’ to traditional sporting
24 norms such as ‘win at all costs’, taking risks and ‘playing through the pain’, the single-
25 minded dedication to a goal, and systematic bodily improvement, leading to dysfunctional or

1 deviant behaviour (Hughes & Coakley, 2001). Overconforming to ‘win at all costs’, for
2 example, may lead to doping (e.g., Lentillon-Kaestner et al, 2012). Similarly, taking risks and
3 ‘playing through the pain’ may lead to injury and depression (e.g., Demulier et al., 2013);
4 whilst striving for systematic bodily improvement can lead to eating disorders (e.g., Scoffier
5 et al, 2012). It appears, then, that in addition to possessing almost super-human physical and
6 cognitive expertise – abilities that are well worthy of study – experts are often rather
7 idiosyncratic in their choice of psychological strategies in competitive settings and may be
8 vulnerable to mental health issues. For example, the boundaries between athletes’ pre-
9 performance routines, superstitious beliefs and apparently obsessive-compulsive behaviour
10 are frequently blurred.

11 More generally, there has been an upsurge of research interest in psychopathology
12 among athletes (e.g., see Brewer & Petrie, 2014) – especially elite performers. Interestingly,
13 epidemiological studies in this field have shown that certain kinds of psychopathology (e.g.,
14 eating disorders, depression) are more prevalent among elite athletes than in the general
15 population or among less proficient performers. For example, prevalence rates for eating
16 disorders such as anorexia nervosa and bulimia nervosa may be higher among collegiate and
17 international elite athletes than in the general population (Brewer & Petrie, 2014). These
18 problems are especially apparent in sports (e.g., gymnastics) in which weight and body size
19 and shape are important. Similarly, Hammond et al. (2013) discovered that the prevalence of
20 depression among their sample of elite athletes (i.e., collegiate swimmers who were
21 competing to represent Canada internationally) was higher than had been reported previously
22 in the research literature. In particular, these authors reported that the prevalence of
23 depression *doubled* among the top 25% of elite swimmers in their sample – especially after
24 perceived performance failure. Clearly, elite athletes are far from the paragons of physical
25 and mental health that they are often assumed to be. This state of affairs may be a

1 consequence of the fact that elite athletes have to engage in prolonged and intensive training
2 from an early age, often leaving their families at critically sensitive developmental stages in
3 their lives (Bär & Markser, 2013). In short, we should not assume that the practices of experts
4 are to be imitated.

5 **Strengths and Limitations**

6 We believe that the present systematic review has four main strengths. Firstly, it is
7 based on rigorous selection criteria (see details in “Method” section) which enabled us to
8 capture a broad range of recent empirical studies of expertise. Thus, reflecting the
9 interdisciplinary nature of this field, we reviewed journal papers on expertise that were
10 published not only in sport psychology but also in cognitive psychology, neuroscience, and in
11 other relevant fields (e.g., motor learning) . Secondly, in exploring the question of how to
12 define the construct of expertise, we addressed a crucial but unresolved issue in this field.
13 Surprisingly, whereas many reviews (e.g., Williams & Ford, 2008) have examined research
14 findings on expert-novice differences in sport, there has been no evaluation to date of the
15 adequacy of the operational definitions of expertise in the relevant research literature.
16 Without clear agreement about how to define and/or classify expertise objectively in sport,
17 the future of the field is bleak because a question mark hangs over the validity and
18 generalizability of research findings on expert-novice differences. Thirdly, our review has led
19 us to postulate a classification system which distinguishes between four types of elite
20 performer – semi-elite, competitive-elite, successful-elite, and world-class elite athletes (see
21 earlier for details). This classification system is not intended to be definitive – but merely an
22 heuristic device to encourage expertise researchers to think carefully before selecting their
23 samples. Finally, in questioning prevailing assumptions about the *meaning* of expertise, we
24 also questioned certain assumed characteristics (e.g., invulnerability to mental health issues)
25 of expert athletes.

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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
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	

1 Table 2
 2 *Definitions Provided for Elite/Expert Athletes, with Number (N) and Percentage (%) of*
 3 *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		
Experience	45	49.45	Participation in national leagues	5	5.49		
			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	
Professionalism	27	29.67	Games played for country	1	1.1		
			Professional	12	13.19		
			Playing in professional leagues	12	13.19		
			Semi-professional	3	3.3		
Training	17	18.68	Commercial sponsorships	1	1.1		
			Daily	1	1.1	6.54 hr	
			Weekly duration	12	13.19	13.08 hr	4-48 hours
Involved in talent development	11	12.09	Weekly frequency	6	6.59	5.68times	3-16 times
			Members of elite sport institutes/training centres	7	7.69		
			National development programs	3	3.3		
Regional level	9	9.89	Athletic scholarships	1	1.1		
			Regional level	5	5.49		
			State	4	4.4		
Sport/country-specific measures	9	9.89	Provincial	3	3.3		
			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		
University	7	7.69	Ministerial list compiled by government	1	1.1		
			NCAA Div1	1	1.1		
			Varsity	2	2.2		
			University teams	2	2.2		
			University students	2	2.2		

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

1 Table 3

2 *Rationales for Sampling Experts and Studies Drawing Theoretical Conclusions about*3 *Expertise in Sport*

4

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); Gldenpenning 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	

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1 Figure 1

2 *Summary of Findings and Model for Classifying the Validity of Expert Samples in Sport*

3 *Psychology Research*

Variable/score	1	2	3	4	
A. Athlete's highest standard of performance	Regional level; university level; semi-professional; 4 th tier leagues or tours	Involved in talent development; 3 rd tier professional leagues or tours	National level; selected to represent nation; 2 nd 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 3 rd /4 th tier	National titles or success at 2 nd /3 rd 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	

4

Highlights

- The primary aim of this review was to evaluate definitions of elite/expert athletes
- The rationale for using such athletes, and conclusions drawn, were also reviewed
- 91 studies were identified through a comprehensive search of four databases
- Eight ways of defining elite/expert athletes were identified, ranging in validity
- A model is proposed to classify elite/expert samples and recommendations are provided

Title	Describe sample as elite/expert in title or abstract?	New insights about psych of elite athletes/ expertise?	Definition of elite/expert athletes	Rationale for using elite/expert sample	Access/ recruitment	Conclusions drawn relative to sample used
1. Action anticipation beyond the action observation network: a functional magnetic resonance imaging study in expert basketball players. Abreu et al (2012)	Yes	Yes	Sixteen basketball players (experts) who had been playing for 3– 21 years (aged 19–30 years, mean 22.25 years, SD 3.42 years) and sixteen subjects with no motor or visual expertise in basketball (these participants had never played professionally or at an amateur level and did not attend basketball matches or watch them on television) (novices) (aged 19–37 years, mean 27.44 years, SD 4.59 years) participated in this study. All participants were male and right handed. The expert players were recruited from B and C Italian series professional leagues; they trained for a mean of 5.69 h (SD 1.62 h) per week, having played basketball for a mean of 12.09 years (SD 4.71 years). The expert players had thus accumulated around 468–6552 h of practice (mean \bar{x} 3680 h, SD \bar{s} 1759 h) since they had initiated playing.	Together, and in tune with previous findings, these studies showed more accurate anticipation judgments in experts compared with novices. Moreover, when compared with novices, experts showed enhanced activation in fronto-parietal and temporal areas involved in action observation and action anticipation (Wright et al., 2010, 2011), and two enlarged event- related potential components, a P300 with parietal distribution and a P2 with posterior–occipital distribution possibly related to perceptual learning (Jin et al., 2011).	None provided.	Abstract: This functional reorganization highlights the tight relationship between action anticipation, error awareness and motor expertise leading to body-related processing and differences in decision-making processes. Taken together, these findings substantiate the existence of an expertise-specific network that is activated during anticipation of observed actions. This network spreads beyond the classical frontoparietal nodes of the AON system. This pattern of results suggests that expertise does not only arise from the accumulation of experience contributing to strengthen the AON, but also depends on other components that allow for a fine detection of correct body cues, awareness of errors and strong embodiment of the observed action.
2. Gender differences in fear of success: A preliminary validation of the performance success threat appraisal inventory André & Metzler (2011)	Yes	Yes	Study 1: Four hundred and nine elite athletes (M age \bar{x} 25.32 years; SD \bar{s} 9.33 years) (260 men and 149 women) from the National Institute of Sport and Physical Education of Paris (INSEP) and other elite sport institutes were recruited Study 2: Participants were 133 voluntary elite athletes (M age \bar{x} 22 years, SD \bar{s} 7 years) (61 females and 72 males) from the National Institute of Sport and Physical Education of Paris (INSEP) and other elite sport institutes.	Unclear. Assumed differences according to gender. because FS measure was developed in competitive achievement situations (e.g., medical school), its generalization to highly competitive sports settings was evaluated, particularly in terms of anxiety in males and females elite athletes.	Four hundred and nine elite athletes (M age \bar{x} 25.32 years; SD \bar{s} 9.33 years) (260 men and 149 women) from the National Institute of Sport and Physical Education of Paris (INSEP) and other elite sport institutes were recruited	Abstract: Evidence of the multidimensional structure of the PSTAI was obtained. Consistent with theoretical predictions, elite athletes are interested by mastery approach and they tend to report fear concerning their capabilities to progress, despite effort. In conclusion, individuals who score high on FS tend to report anxiety, self-doubts and problems of concentration, give evidence of being preoccupied with rewards, and display a tendency to suffer a lack of freedom in their relations with others. Moreover, regardless whether they employ a mastery approach, they also tend to report fear concerning their capabilities to progress. Overall, the current results provided evidence of the multidimensional structure of the PSTAI.
3. "Neural efficiency" of experts' brain during judgment of actions: A high-resolution EEG study in elite and amateur karate athletes. Babiloni et al (2010)	Yes	Yes	We recruited 17 (7 women) elite karate athletes, 15 (8 women) amateur karate athletes, and 17 (11 women) non-athletes. All subjects were right-handed as revealed by Edinburgh inventory. The elite karate athletes were part of Italian national karate team. They had been practicing karate for more than 12 years at least five times a week. They also regularly compete in national and international tournaments.... The mean subjects' age was 23.8 years in the elite karate athletes (± 1 standard error, SE; range: 20–33 years), 21.5 years in the amateur karate athletes (± 2 SE; range: 17–33 years), and 24.6 years in the non-athletes (± 1.4 SE; ranging from 17 to 35 years).	Secondly, we could test the control hypothesis that the elite karate athletes globally followed the implicit judgment rules of their coach, the amateur karate athletes globally gave an approximate evaluation of athletes' performance, and the non-athletes globally gave an uneducated evaluation of athletes' performance. Of note, the recruited elite athletes had received several months of daily, intense (4–6 h) training under the continuous technical guidance/feed-back of their coach.	None provided.	Abstract: In conclusion, athletes' judgment of observed sporting actions is related to less pronounced alpha ERD, as a possible index of "neural efficiency" in experts engaged in social cognition. In conclusion, the present study showed that that low- and high-frequency alpha ERD was less pronounced in the elite karate athletes compared to the non-athletes in the dorsal and frontoparietal "mirror" pathways. Furthermore, low-frequency alpha ERD showed an intermediate amplitude in amateur karate with respect to the non-athletes and elite karate athletes in the dorsal pathway. These results globally suggest that the judgment of observed sporting actions is related to relatively less pronounced alpha ERD, as a possible index of spatially selective cortical activation or "neural efficiency".
4. Motivational and sportpersonship profiles of elite athletes in relation to doping behaviour	Yes	Yes	Greek elite-level athletes from nine different sports [football (N \bar{x} 479), basketball (N \bar{x} 156), volleyball (N \bar{x} 148), handball (N \bar{x} 148), athletics (N \bar{x} 128), swimming (N \bar{x} 96), archery (N \bar{x} 58), Tae Kwon Do (N \bar{x} 90), and rowing (N \bar{x} 137)] participated in the present study. Criteria for participation included systematic participation in trainings and games in professional leagues (A1 for basketball, volleyball and handball teams and	Tacit assumption that elite athletes are more likely to be tempted by doping. Therefore, the aim of the present study was to assess the motivational, achievement goals, and sportpersonship profiles of elite-level athletes, in relation to doping behavior... it was hypothesized that athletes who have a low self-determination profile, adopt performance and avoidance goals, and report lower sportpersonship	None provided.	Abstract: The findings of the present study provide valuable information on the motivational and sportpersonship orientations of athletes who have used or intend to use doping substances. Overall, the findings of the present study indicate that different motivational profiles were associated with both self-reported PED use and future doping intentions. More specifically, athletes with low self-determined profile and athletes adopting

Barkoukis et al (2011)			Super League for football teams) for the past 5 years (for team sports athletes), as well as participation in the finals of the national and/or international championships during the past 5 years (for individual sports athletes)	profiles would be more likely to report past use of PED and stronger intention for doing so in the future.		avoidance goals were more susceptible to use such substances. On the other hand, no significant differences emerged as a function of the athletes' sportspersonship profiles, implying that the use of prohibited substances is not associated with the moral practices and beliefs of athletes... To this direction, our findings suggest that motivational and achievement goal profiles play a major role in doping abstinence
5. Superstitious beliefs as moderators in the achievement goals: competitive anxiety relationship Barkoukis et al (2012)	Yes	Enough to include	Elite male basketball players participating in national leagues took part in the study (N = 221). The mean age of the players was 23.71 years (SD = 6.78). In the study participated players with experience for more than 5 years (mean experience in national leagues = 13.00 years, SD = 7.07) while those with less experience were excluded from the study.	There is only limited evidence about this relationship on elite level athletes. As Abrahamsen et al (2008) noted there is clearly a lack of literature investigating the effect that achievement goals have on elite athletes' experiences of competitive trait anxiety.	Team managers were contacted and permission was granted to conduct the study.	Abstract: The findings support the application of the 2x2 approach in sport settings and provide valuable information on the role of superstitious beliefs may play during sport involvement. Overall, the findings of the present study indicated that achievement goals can predict competitive trait anxiety. The addition of mastery avoidance goals was a meaningful one as, consistently with the theoretical predictions, emerged as a significant predictor of trait anxiety dimensions. Hence, the 2x2 achievement goal approach may be an important development in achievement goal literature helping to the better understanding of athletes' cognitions, affect and behaviour. Superstitious beliefs moderated only the performance goals (approach and avoidance) effect of on trait anxiety, suggesting that these athletes are more prompt to adopt such beliefs. IN addition, they moderated the effect of performance goals on worry and concentration disruption, which is the cognitive element of anxiety. This supports evidence that superstitious beliefs are used by the athletes to 'fight' the uncertainty, or uncontrollability during sport involvement.
6. Identifying mediators of training effects on performance-related psychobiosocial states: A single case observational study in an elite female triathlete Barnett et al (2012)	Yes	Yes	An elite international female triathlete (22.2 y, 1.71 m, 57 kg)	Attempt to demonstrate the efficacy of a novel research design with a single case elite athlete to show that sampling difficulties can be overcome. Applied sports scientists strive to understand and quantify how physical training impacts on the performance of individual elite athletes... However, elite athletes are reluctant to participate in such trials as they are disruptive to their established training regimen and may lead to performance decrements. In these circumstances, a naturalistic, observational approach without research-driven manipulation of training or PBS states becomes the only viable alternative.... This methodological study aims to illustrate how naturalistic idiographic data on training, PBS states and performance-related self-efficacy can be analysed and interpreted using DLMS and mediation analysis. For this purpose, we used data collected from an elite triathlete across a training period.	None provided.	In this paper we have presented an example of how the combined use of DLMS and mediating variable analysis can provide information on the dynamic relationships between training loads, PBS states, and performance-related self-efficacy... In this paper we presented an example of how potential mechanisms of training-self-efficacy associations can be retrospectively dynamically examined in individual athletes using DLMS and mediation analyses.
7. <u>From attentional control to attentional spillover: A skill-level investigation of attention, movement, and performance outcomes.</u> Beilock & Gray (2012)	Yes	Yes	1: Participants were undergraduate students from Arizona State University. Novice golfers (n = 10) had no previous golf experience. Skilled golfers (n = 10) had a Professional Golf Association (PGA) handicap of <10 and, on average, 8.3 years of competitive golfing experience. All participants were naïve to the aims of the experiment and were paid an hourly rate for study participation. The study was approved by the Arizona State University Research Ethics Committee and all participants gave informed consent. 2: Participants were undergraduate students from Arizona State University. Novice golfers (n = 10) had no previous golf experience. Skilled golfers (n = 10) all had a Professional Golf	As described above, putting in experts is thought to involve distinct phases which utilize different control modes, therefore, it is likely that there would be large differences in the effect a secondary task depending on its timing. As discussed above, it has been reported that expert golfers primarily regulate the downswing amplitude (rather than movement time or club head speed) to appropriately control club head force for different distances, with differences in the downswing amplitude (as a function of hole distance) as the main kinematic variable that distinguishes novice and expert golfers (Delay et al., 1997).	None provided.	In conclusion, in the current work, we not only show how changes in attentional control impact performance but, more so, how this impact occurs – via changes in the movement variables governing performance. We show that such attentional effects differ as a function of the skill level of the performer and when in the putting stroke they are imposed. Moreover, we demonstrate that instructions that alter attentional control need not be present on all trials, but that shifts in attention can spillover from one skill attempt to another. This work serves to further our knowledge base of the cognitive control structures governing performance, knowledge that will help to advance our understanding of skill level differences and aid in the enhancement of performance at all levels of learning.

			Association (PGA) handicap of <10 and, on average, 9.2 years of competitive golfing experience. All participants were naïve to the aims of the experiment and were paid an hourly rate for study participation. The participants used in Experiment 2 were not the same as those used in Experiment 1. The study was approved by the Arizona State University Research Ethics Committee and all participants gave informed consent.			
8. The attentional focus of expert golfers in training and competition: A naturalistic investigation Bernier et al (2011)	Yes	Yes	Eight male professional French golfers voluntarily participated in the study.... Participants were 24–37 years old (M = 30.87, SD = 4.42) and had practiced golf for 11–23 years (M = 19.00, SD=4.41). At time of the study, they trained 18 to 30 hr a week (M =26.00,SD=4.97). Various other characteristics allowed for appraising their level of expertise in golf. First, they were all good amateur players before turning professional. Each participant was at least selected once to play on the national team for an international tournament. Second, all participants played on various professional tours. One participant was a regular European Tour player, a second had partial access to the European Tour while three were Challenge Tour players and the last two played on the Alps Tour. Their participation in these professional competitions indicates a high level of performance in competitive golf to have access or maintain access at a professional tour.	In summary, literature on attentional focus in expert performance can be considered somewhat consistent on some issues and inconsistent for others. It is generally agreed that an internal focus of attention is detrimental to expert performance... Moreover, few studies have dealt with attentional focus in expert sport. As recommended byWilliams and Ericsson (2005), the present study was designed to take into account the complex mechanisms that mediate truly expert performance in dynamic and uncertain conditions, with specific physiological and emotional demands. In a naturalistic approach, the goal was to examine attentional focus in natural settings experienced by expert golfers. Contrary to previous research in the field, we did not set out to evaluate the effectiveness of different kinds of attentional focus on performance, but rather to employ a qualitative method to explore and to characterize more precisely the attentional focus of expert golfers in natural situations of training and competition.	Players were contacted during a coach education class. They were informed that their participation would advance knowledge in golf performance, and that they would be informed about the results of the study during classes given to coaches by the National Golf Governing Body.	In summary, the classification that emerged from the analysis of data is related to many relevant themes in cognitive psychology (e.g., the perceptual process, mental imagery, deliberateness in visual attention) that have not been explicitly addressed in previous studies considering attentional focus. These associations between the various notions of attentional focus and other themes in cognitive psychology are worthy of further research in sport psychology. These new classifications can also be applied to better understand the attentional focus of athletes.
9. Functions of mental imagery in expert golfers Bernier & Fournier (2010)	Yes	Yes	Study 1: Twenty-one expert golfers (6 female and 15 male; M age¼26.36, SD¼4.68) volunteered to take part in this research study. The participants had practised golf for 12e25 years (M¼16.31, SD¼3.38). According to criteria defined by Ericsson, Krampe, and Tesch-Römer (1993) they were thus considered expert athletes. Nine players were elite amateur golfers and had a handicap between 1 2 and 6. Three of them participated in international amateur tournaments (European and World Championships). The other twelve participants were professional golfers and had competed in various professional tours (Alps Tour, Challenge Tour, European Tour). Because they were professionals, they did not have official handicaps but their play level corresponded to a negative handicap. Study 2: Thirty-one amateur golfers (28 men and 3 women;Mage¼25.61, SD¼4.28) volunteered to participate in the present study. They had practised golf for 11e23 years (M¼16.14, SD¼3.32). According to Ericsson et al. (1993)they were considered expert athletes. Their golf handicaps were between -2 and +6... Players were divided into the two groups based on performance and imagery skill criteria. They were first ranked based on their most recent official handicap. However, they complained that the handicap was not a good indicator of their current level of	Exploratory – aimed to replicate previous findings and explore concepts. Tacit assumption that elite golfers would have better developed imagery skills. The goal of this first qualitative study was to describe mental imagery used by expert golfers regarding its content (what does an expert golfer imagine in preparing the shot?), its characteristics (how does the golfer imagine it?), its functions (why does the golfer use these images?) and the links between these three elements. The study also explored the influence of the situation on imagery use. The study was based on a design with three qualitative methods in order to optimise data collection. As this study was exploratory, researchers took into account the images used by golfers in ecologically valid conditions.	None provided.	Abstract: Results confirm the links among function, content and characteristics of imagery postulated recently...Taking into consideration these functional links should enhance the relevance of future research and help the sport psychology practitioner to better understand athletes' use of imagery. Results of the present two studies enhance our knowledge about the three imagery elements revealed in recent studies... Additionally, results of the present article confirm the presence of links among imagery function, content and characteristics... Results confirmed some of the recent findings in the literature

			play and they took it upon themselves to modify the first ranking based on the most recent competitive results. All the participants validated the ranking.			
10. Temporal pattern of pre-shooting psycho-physiological states in elite athletes: A probabilistic approach Bertello et al (2012)	Yes	Yes	Eight elite athletes (the Italian Olympic air-pistol shooters team, including two women) were recruited for this study. The elite airpistol shooters have been regularly competing in national and international tournaments; they had been practicing pistol shooting for more than 10 years and for at least five times a week. The mean participants' age was 29.2 years (1.6 SD, range: 21e45 years).	In summary, studies on the temporal pattern of emotional, psychophysical, psycho-physiological indices in shooting were limited to a group analysis of data, with the aim of comparing novice vs. expert or worst vs. best performance outcomes. This "performance-based" between-individuals methodology overlooks performance dynamics at the individual level. In contrast, the IZOF-based probabilistic approach provides a feasible methodology to study within-individual patterns of a performer's states... We expected that the probabilistic method would permit us to discern the contribution of arousal/activation and vigilance to optimal and non-optimal performance in elite shooters better than the performance-based approach, thereby providing a sharper representation of the temporal pattern of performers' states before shooting.	None provided.	Abstract: The probabilistic method better discerned the contribution of arousal/ activation and vigilance to optimal and non-optimal performance in elite shooters, thereby providing a sharper representation of the temporal pattern of performers' states before shooting. From an applied perspective, we believe that the probabilistic approach can help athletes become aware of the subtle variations occurring in their psychophysical states during the preparatory period preceding the shot and not only at the moment of shot release. The probabilistic method was successfully applied to the study of the time course of psycho-physiological indices in elite shooters, thereby enabling us to differentiate the contribution of arousal/ activation and vigilance to both optimal and non-optimal performance.
11. Performance Milestones in the Development of Expertise: Are They Critical? Bruce et al (2013)	Yes	Yes – interesting paper too, decent critique of 10,000 hours rule	The expert group consisted of 19 netballers (<i>Mean</i> = 24.5, <i>SD</i> = 4.4 years) who possessed an average of 17.5 years of playing experience (<i>SD</i> = 4.0) and were all members of the Australian National open-age netball squad. Experts first represented Australia in open level competition (<i>Mean</i> = 14.1, <i>SD</i> = 3.1 years) after they began playing netball and after an average of 6050.5 hr (<i>SD</i> = 3234.5) of accumulated netball experience.	Although researchers have collected data relating to performance milestones, there is very limited statistical evidence examining differences between skill levels and/or sports to determine if any differences that may occur are predictors of achievement of expertise. To date the majority of research in this area has focused on comparing a highly skilled or expert group of adult athletes to a lesser skilled or novice group of adults. Few studies have compared an expert group of adults to a group of sub-elite athletes who are still progressing along the developmental pathway. The inclusion of a novice group of athletes is important to ascertain whether they are achieving the same milestones as the expert and sub-elite athletes, and if not is this potentially limiting their ability to achieve expertise. Additionally, there has been limited research that has focused on the development of expertise in female athletes, and in particular, female team sport athletes. In other words, do female athletes follow a similar developmental path to their male counterparts?	None provided	Abstract: These findings are discussed in relation to contemporary models of skill development, namely deliberate practice (Ericsson, Krampe, & Tesch-Römer, 1993) and the developmental model of sport participation (Côté, 1999) and the underpinning socioenvironmental factors that may influence sport participation and subsequent development of expertise. The current study, unique in that it examined the performance milestones and developmental histories of expert, national talent identified junior athletes and recreational participants in a predominately female team-based sport revealed some similarities to previous research, but also highlighted some differences. The current study observed that more than 10 years of participation was required for the attainment of national team selection, however, national team athletes did not invest 10,000 hr of sport-specific practice prior to national team representation. This suggests that it may not be critical to achieve this milestone (10,000 hr of practice) prior to achieving a very high level of team-sport performance. Earlier participation in sporting activities appears to be beneficial in the development of expert sporting performance. It is recommended that children engage in sporting activities at an early age to allow their fundamental motor skills to develop as developing the fundamental motor skills provides a foundation for sport-specific skills (Lubans et al., 2010).
12. But I can't pass that far! The influence of motor skill on decision making Bruce et al (2012)	Yes	Yes	The expert group consisted of 19 netballers (mean age 24.3 ± 4.8 years) who possessed an average of 17.6 ± 4.3 years playing experience and were all members of the Australian National open-age netball squad.	It has not been shown whether motor skill constrains decision making for perceptual-cognitive and perceptual-motor tasks. It seems reasonable to expect that the superior motor skills of expert performers will facilitate superior outcomes once a decision is made for movement execution in a game, yet it is not known whether a lack of skill development will constrain the actual decisions made by players. Furthermore, it is not known whether the inferior motor skills of lesser-skilled participants will limit decisions even when the ecological validity of a task is reduced to a perceptual-cognitive task requiring a verbal response to a videobased display	None provided.	This study sought to investigate the influence of motor skill on perceptual-cognitive and perceptual-motor decision making across different levels of sporting expertise. As expected, performance on the motor skill-execution test was directly related to expertise, with experts possessing greater passing accuracy than the developmental athletes, who in turn were superior to the lesser-skilled participants. Decision making performance was superior for the perceptual-motor task compared to the perceptual-cognitive task, and the expertise effect was most pronounced in the perceptual-motor task due to the experts' ability to successfully couple their decision with successful pass execution. Sensitivity analysis revealed that experts were better able to distinguish between, and appropriately respond to, scenarios of differing lengths, namely a long and short passing option.

13. The competitive goal effectiveness paradox revisited: Examining the goal practices of prospective Olympic athletes Burton et al (2010)	Yes	Yes	An extensive goal-setting questionnaire was completed by 338 prospective Olympic athletes (i.e., 187 males and 151 females) from 12 different individual and team sports. Actively competing athletes were chosen to facilitate response validity and reduce memory bias. The sample was selected by coaches and administrators from the 12 U.S. Olympic Committee (USOC) National Governing Bodies (NGBs) who identified athletes who had a strong probability of making the next U.S. Summer Olympic team in 2 years. On average, participants were 24.6 years of age (SD = 6.9 years), had participated in their sport for 10.4 years (SD = 5.6 years), and had set goals for 7.8 years (SD = 5.8 years). The elite nature of the sample is documented by 90% having competed at nationals, with 80% medalling, and 21% having made at least one Olympic team, with 6.4% having medalled.	Although physical activity goal-setting studies have revealed that goals prompt significantly better performance than do the absence of goals, the factors that influence goal-effectiveness have received minimal empirical attention in sport (Burton & Naylor, 2002; Burton & Weiss, 2008). Moreover, sport populations, particularly elite samples, have seldom been used, and performance has rarely been employed as a dependent variable (Burton & Weiss, 2008)... the general purpose of this study was to explore perceptions of elite athletes about their goal-setting patterns, strategies, and beliefs to gain greater insights into real-world goal effectiveness practices	NGB administrators were contacted to seek their sport's participation, a list of names and addresses of potential Olympic athletes in their sport, and a cover letter endorsing the study and requesting athlete participation. Questionnaires along with cover letters and prepaid return envelopes were mailed out to all identified athletes	This elite sample placed more importance on the effectiveness of competition goals but the frequency of general, long-term goals, suggesting that athletes focused on long-term goals frequently but were more concerned about the effectiveness of their competitive goals, perhaps because competitive goal-effectiveness provides a means to assess progress towards attaining long-term goals. Overall, the goal-effectiveness profiles seem to reflect major categories of goal-setters that the authors frequently see as sport psychology consultants. These results suggest that effective elite goal-setters are more committed to goal-setting and set all types of goals more frequently than do their less effective counterparts. Moreover, multifaceted goal-setters were more confident and had greater career sport success than the other three groups. The implication is that goal-setting is related to confidence and performance, and goal frequency and commitment may mediate this relationship between positive perceptions and improved performance.
14. Living, resisting, and playing the part of athlete: Narrative tensions in elite sport Carless & Douglas (2013)	Yes	Yes	The participants comprised 21 elite and professional athletes (11 female, 10 male) between 18 and 44 years of age and registered on the UK Sport Council's athlete support program. Participants were drawn from the following sports: track and field athletics, rowing, rugby union, swimming, cricket, judo, canoeing, hockey, and netball.	The need to integrate sociocultural and psychological perspectives is particularly acute if we are to better understand the lives of elite and professional sportspeople. Athletes inhabit a culture awash with public stories relating to (preferred) identities, (expected) behaviors, and (assumed) developmental trajectories. These stories are widely circulated and amplified by the sport media. We have suggested, however, that one particular narrative type is dominant within elite sport culture: a performance narrative (Douglas & Carless, 2006a). The plot of performance stories revolves around achieving performance outcomes (e.g., winning and/or being the best), underlying many stories recited by the media, coaches, sport policy makers and governing bodies, and athletes (Carless & Douglas, 2012). It is a story of single-minded dedication to performance to the extent that phrases like "winning is everything" are routine. In this narrative, performance-related concerns come to infuse all areas of life while other areas are diminished or relegated.	None provided.	This study reinforces research in sport and exercise psychology...which has shown that development, identity, and behavior are not simply a product of psychological processes located 'within' individuals, but powerfully shaped by sociocultural factors. It extends existing research in professional golf (e.g., Carless & Douglas, 2009; Douglas & Carless, 2006a, 2009a) by making these processes visible in the context of several other elite and professional sports. In addition to showing that these processes occur, our study develops recent research by revealing how they occur through identifying and detailing three psycho-sociocultural processes experienced by elite athletes.
15. <u>Predictors of pre- and post-competition affective states in male martial artists: a multilevel interactional approach.</u> Cerin & Barnett, (2011)	Yes	YES	Twenty-two male Tae Kwon Do and 22 male Karate practitioners participating in a major national competition were recruited for this study. Six participants competed at international and 38 at national level... The group of martial artists who completed the study ranged in age from 16 to 53 years (26.77 ± 7.75) and had a mean training experience of 10.40 years (SD56.47).	Given the athletes' likely high levels of importance attributed to the competition and high levels of perceived sport competence, it was hypothesized that competition-related concerns would, in general, be perceived as more important and controllable than their counterparts.	None provided.	Abstract: This study supports the idea that cognitive appraisal and situational and personality factors exert main and interactive effects on athletes' pre- and post-competition affects. These factors need to be accounted for in planning of emotion regulation interventions. This study highlighted the importance of competitive trait anxiety as both a moderator of the relationships between appraisal and affective states and a determinant of affective states, while neuroticism and extraversion were identified as determinants only. Sport psychologists need to identify athletes that are high in competitive trait anxiety and neuroticism, help them develop a more positive attitude toward competition and reduce negative affects that may be detrimental to performance.
16. Self-determined forms of motivation predict sport injury prevention and rehabilitation	Yes	Seems to focus on sport in general, but enough to include	Questionnaire data were collected from 214 elite athletes (mean age [19.3 ± 4.0 yr], 43.0% male) for Study 1 and another group of 533 elite athletes (mean age [16.8 ± 2.8 yr], 50.3% male) for Study 2. They were international, national or regional level athletes from 13 different sports (e.g. athletics, canoeing, cycling, soccer and swimming), and received elite training for more than 1 yr (Study 1 [6.3 ± 3.8 yr],	The TPB has received considerable support in a variety of health contexts, 7,8 including safety 9-12 and rehabilitation. 13,14 However, there has been a relative dearth of research applying the TPB into the sport injury prevention and rehabilitation of elite athletes, 12 even though this group of individuals typically experiences higher risk of sport injury. 15 While the injury is as well regarded as one of the key factors contributing to the risk of participation and premature	None provided.	Abstract: Motivational regulations from SDT might serve as sources of information that influence athletes' intentions through their impact on the attitude, perceived social norm and controllability of injury rehabilitation and prevention. Findings of the present investigation provide preliminary validation of an integrated model of SDT and TPB in the context of sport injury rehabilitation and prevention. The results generally supported the hypothesised motivational sequence in

intentions. Chan & Hagger (2012)			Study 2 [3.2 ± 2.2 yr]) in the Sichuan province of China.	retirement ¹⁵ as it is in some of the high-risk occupations, the motivational and social cognitive factors associated with injury in the workplaces might plausibly be relevant to the rehabilitation and prevention of injury in elite sport. There is, therefore, a need for further replications of this integrated model.		the model, suggesting that athletes' volitional orientations were closely related to intentions to engage in sport injury rehabilitation and prevention.
17. Evaluating the master-avoidance goal construct: A study of elite college basketball players Ciana & Sheldon (2010)	Yes	Yes	Eight baseball players at a large public university in the Midwest were recruited to participate in the study. The athletes were all teammates on the university's Division I NCAA men's baseball team, which has performed at a high level, nationally, the last few years... Of the eight participating student athletes, five were regular starters in the field, two pitchers were used intermittently in the rotation, and one was a backup fielder that saw limited playing time. Two players were in their first year on the team, three players were in their second year, and the remaining three were in their final year of eligibility.	Given the controversy surrounding the construct, it appears that researchers and theorists alike could benefit from a greater understanding of what MAV [mastery avoidance] items mean to athletes, especially elite ones.	The players were enrolled in, and recruited from, an introductory seminar course	Abstract: Our findings suggest that mastery-avoidance goals may be uncommon, and that high ratings may indicate misinterpretation of the item rather than actual avoidance goals. Our results support this claim as only two of the nine MAV endorsements were paired with a valid interpretation of the goal item. These results indicate that high ratings of MAV goal items may often be the result of misinterpreting the item as an approach goal, making true MAV endorsement, at least in college-age athletes, somewhat rare. In 1999, Elliot posed hypotheses about the role of MAV within the 2 _ 2 achievement goal framework, and asked researchers to "fully attend to this construct" (p. 182). The current results suggest that more research is needed to find ways to measure the construct without contamination by approach goals. Unfortunately, if such measures are developed, they may reveal that true MAV goals are quite rare.
18. Enhancing the Cohesion and Performance of an Elite Curling Team Through a Self-Regulation Intervention Collins & Durand-Bush (2010)	Yes	Yes	Participants were members of an elite curling team, that is, four women (n = 4, skip, third, second, and lead [25]) and their male coach who were competing against national and international level teams. Each athlete was between 18 and 20 years of age; the coach, who was 63 years of age, had been coaching the team for over eight years, and had previously coached other teams at an international level.	Exploratory. The purpose of this study was to document if and how members of an elite curling team could enhance their cohesion and performance by engaging in a learning process designed to help them self-regulate, particularly, their felt experience	During the recruitment stage, potential coaches were contacted via telephone and the purpose of the study , as well as the commitment required, was outlined. The researcher met with the team interested in participating and the study was explained to all athletes.	The chronological narrative presented in this article demonstrates the lived experiences of a curling team throughout an entire season and helps to understand the process by which a consultant and researcher conducted an intervention to help both the athletes and the coach increase self-regulation to manage their thoughts, behaviours and their individual and collective feel, particularly in the face of obstacles.
19. A lifespan perspective on transitions during a top sports career: A case of an elite female fencer Debois et al (2012)	Yes	Yes	the present paper sets out the case of an elite athlete who followed the Olympic route twice and participated once.... The participant in this study was Francine (alias), a female elite fencer. Francine began to practice foil in a club at the age of 8 and entered the junior national foil-training centre aged 18. She achieved her first selection for the World Championships at 19 years old. A year later, she entered the elite foil-training centre...At 23 years old, she entered the elite sabre-training centre...At the age of 26, she won the European title, a bronze medal at the World Championships and three World Cup events. When she was 28 years old, she ended thirteenth at the OG. She then took a break to have a baby. She returned to training at the age of 29. Between the ages of 30 and 31, she won a team gold medal in each of the two World Championships preceding the OG. At 32 years old, Francine failed to qualify for the OG and decided to end her fencing career.	It [motherhood] also enriched their sport experience through higher resilience and adaptability when dealing with the challenges of elite sport.	The fourth author, who knew the participant in her role as a sport psychologist working for the fencing federation, contacted her and explained the aim of the present study... 52 psychological consultation interviews [were conducted with the athlete and used as data].	Abstract: This study provided an illustration of the ups and downs that elite athletes may face in their pursuit of excellence and invites questions about the conditions which would best contribute to the effectiveness of psychological intervention for enhancing both performance and personal growth. The question, as an applied sport psychologist, is then to find the balance between accompanying athletes at each turning point of their path and working in advance, as soon as they entire high level sport to help them avoid negative transitions as much as possible... This case study illustrates the importance of carrying out more research on the role and influence of non-athletic transitions which may affect the sport career, especially during the Olympic stage which carries high pressure due to its very specific context... Finally, it brings to the fore the importance of anticipating and planning normative athletic as well as non-athletic transition experiences as early as possible to reach the Olympics in the best condition.
20. Functional coupling of parietal alpha rhythms is enhanced in	Yes	Yes	Eighteen (eight women) elite athletes (air pistol shooters) and 10 non-athletes (five women) were recruited for this study. The elite air pistol shooters have been regularly competing in national and international tournaments; they also	Here, we tested the hypothesis that in elite pistol shooters, "neural efficiency" mechanism is associated with an enhanced functional coupling of posterior cortical regions involved in task-relevant attentional processes and visuo-motor transformations, as a reflection of an improved	None provided.	Abstract: These findings suggest that under the present experimental conditions, elite athletes are characterized by the stabilization of functional coupling of preparatory EEG rhythms between "visuo-spatial" parietal area and other posterior cortical areas.

athletes before visuomotor performance: a coherence electroencephalographic study. Del Percio et al (2011)			had been practicing pistol shooting for more than 8 years and for at least five times a week... The mean subjects' age was of 29.2 years (\pm 1.6 standard error, SE; range: 21– 45 years) in the elite athletes,	cortico-cortical functional connectivity in the regions representing visuo-spatial information and sensorimotor integration including eye-hand coordination.		These findings suggest that in the present experimental condition, "neural efficiency" of elite athletes is associated with a stabilization of functional coupling of preparatory alpha rhythms over parietal visuo-spatial cortex.
21. Psychological Predictors of Career Planning among Active Elite Athletes: An Application of the Social Cognitive Career Theory. Demulier et al (2013)	Yes	Yes	Participants were 180 French active competitive athletes, registered as elite on a ministerial list compiled by the French government (92 males and 88 females), who volunteered to participate in the study. Age ranged from 16 to 29 years (<i>Age</i> = 20.36, <i>SD</i> = 1.46). The following sports were represented: archery (<i>n</i> = 1), badminton (<i>n</i> = 6), basketball (<i>n</i> = 5), biathlon (<i>n</i> = 2), boxing (<i>n</i> = 2), canoe (<i>n</i> = 11), cycling (<i>n</i> = 5), fencing (<i>n</i> = 19), figure skating (<i>n</i> = 2), football (<i>n</i> = 4), gymnastic (<i>n</i> = 3), handball (<i>n</i> = 6), ice hockey (<i>n</i> = 5), judo (<i>n</i> = 8), karate (<i>n</i> = 5), pentathlon (<i>n</i> = 1), inline skating (<i>n</i> = 1), rowing (<i>n</i> = 12), rugby (<i>n</i> = 7), ski (<i>n</i> = 16), swimming (<i>n</i> = 19), target practice (<i>n</i> = 2), track and field (<i>n</i> = 27), triathlon (<i>n</i> = 5), and volleyball (<i>n</i> = 6). Participants competed at international (<i>n</i> = 164) and national (<i>n</i> = 16) levels at the time of the study. They were active elite athletes for an average of 8.42 years (<i>SD</i> = 4.34), expecting to end their career in an average of 3.98 years (<i>SD</i> = 1.69). Their reported weekly training averaged 15.27 hr (<i>SD</i> = 7.35).	In addition to an epidemiologic interest in sport injury, high injury rates are of widespread concern to those involved in assisting elite athletes with the psychosocial consequences of injury. A wealth of evidence indicates that sport injury can be an extremely stressful and emotionally disruptive event for elite athletes, particularly in cases where the injury is severe and the athlete is heavily invested in sport.9–11 In addition to having to cope with the physical stresses of injury (eg, pain, discomfort, the rigors of rehabilitation), athletes must contend with the psychosocial stresses of injury such as threats to self-esteem, threats to athletic-career involvement, and isolation from peers.12 Given the profound physical and psychosocial burden of injury, prediction efforts aimed at minimizing injury risk are important. As highlighted herein, the focus of the current investigation was to examine whether specific psychosocial factors could predict sport injuries in a population of professional soccer players.	Questionnaires were distributed via coaching staff, clubs, and federations, or by mail via address lists provided by sport federations or personal contacts. Participants were also provided with a description of research aims and procedures.	Abstract: Implications for practice are discussed in relation to intervention that could induce career planning among athletes The present study contributes to this body of literature as it is the first to identify the factors involved in a pivotal process, crucial to the quality of adjustment to transition out of elite sport, namely retirement planning. It reveals that athletes' personality, and conscientiousness in particular, plays a role in planning the transition out of elite sport. Indeed, conscientiousness appears to be a resource that allows athletes to plan for their future career. Conscientious individuals believe they are capable of planning their post sport life career and set goals with regards to their future career. Furthermore, the present results are consistent with previous research findings obtained in academic settings, on the role of personality, and conscientiousness in particular, in career choice processes... The present research therefore represents a first step towards a more in-depth investigation of the processes underlying an individual's pre-condition towards improved quality of adjustment to retirement from elite sport and, as such, offers fruitful avenues for future research.
22. Exploring the nature of interpersonal influence in elite individual sport teams Evans et al (2013)	Yes	Yes	Six male and eight female individual sport athletes (<i>Age</i> = 22.01 years, <i>SD</i> = 3.00, range = 19–29 years) participated in the current study. All participants were currently competing and had an average experience of 3.7 years (<i>SD</i> = 2.01) at national and international levels (e.g., World Junior Championships and Olympic Games) and were full-time members of elite club, university, or national teams in Canada. Thirteen of the 14 participants were actively competing, whereas one participant was in the off-season. The sample included six mid- and long-distance runners (800m – 10km), six cross country skiers, one mountain biker, as well as one wrestler.	A theoretical (Corbin & Strauss, 2008) and criterion sampling approach dictated the recruitment of participants. The main criteria for inclusion were participation in elite individual sport and current full-time training and competition with a sport team. After conducting the initial interviews with athletes on teams that had no identifiable collective goal, we purposely sought athletes from teams with collective goals as well as older athletes with elite-level experience with several different team environments. This was done to seek athletes with varied perspectives of group settings and with considerable experience to contrast their experiences.	A theoretical (Corbin & Strauss, 2008) and criterion sampling approach dictated the recruitment of participants. The main criteria for inclusion were participation in elite individual sport and current full-time training and competition with a sport team... Access to participants was gained through coaches and administrative staff of elite sport programs, who were asked to forward information about the study to their teams. Athletes were instructed to contact the primary researcher if interested in participating	Abstract: Group experiences are influential for individual sport athletes, and the management of group processes is an important concern for coaches and practitioners. Taken together, athletes' comments about developmental influences suggest that sport groups are an important aspect of even elite individual sport developmental pathways and have applicability across sport contexts.
23. Revisiting the relationship between pattern recall and anticipatory skill Farrow et al (2010)	Yes	Yes	An expert group comprising 20 participants with a mean age of 26.2 years (<i>SD</i> = 2.8) and a mean of 14.9 years rugby playing experience (<i>SD</i> = 5.3) took part in the study. All were current members of the Australian Rugby Union squad and selected to play in the forwards – a position requiring them to be involved in lineout play.	Practically, are pattern recall and anticipation distinct limitations/sub-skills needed for the development of expertise and consequently can they be trained by the same practice drills or do they need to be trained distinctively using different types of practice/skill learning?...This study was designed to address these key issues and in turn permit greater comment on the nature of the underlying processes accessed by performers of different skill levels when completing recall and anticipation tasks.	None provided.	In conclusion, the results of this study reinforce the notion that the perceptual-cognitive skills of pattern recall and anticipation differentiate skilled, intermediate, and novice rugby players. In particular, anticipatory skill was found to differentiate strongly the respective skill groups. Pattern recall was found to be a strong predictor of anticipatory skill, explaining 40% of its variance. However, the collective analyses highlight a number of important methodological and theoretical issues that lead us to question the nature of the link between pattern recall and

<p>24. Situational motivational profiles and performance with elite performers.</p> <p>Gillet et al (2013)</p>	Yes	Yes	<p>Study 1: The sample was composed of 173 French tennis players (108 women and 65 men) with a mean age of 24.79 years ($SD = 7.40$). Participants were engaged in a national tennis competition organized by the French Tennis Federation.</p> <p>Study 2: Participants were 319 French national tennis players (205 women and 114 men) engaged in a national event with a mean age of 24.93 years ($SD = 7.77$). Participants were all different from those of Study 1.</p>	<p>Past investigations have shown that intrinsic motivation was positively related to higher levels of performance, learning, and creativity both in education (Amabile, 1985; Grolnick & Ryan, 1987) and physical activity or low-level sport (e.g., Beauchamp, Halliwell, Fournier, & Koestner, 1996; Biddle & Brooke, 1992). No research has looked at the role of situational motivation in the performance of elite performers. Yet, such research is important as it could identify some of the immediate motivational determinants of high-level performance.</p>	None Provided.	<p>expert anticipation.</p> <p>Abstract: Overall, these results suggest that it is useful to analyze individuals' situational motivational profiles using a cluster analysis to understand the complex link between motivation and performance</p> <p>In sum, the present findings underscore the fundamental role of situational motivation in performance for a specific situation. In two studies, it was found that engaging in a situation with a low self-determined motivational profile leads to performance that is significantly lower than that of participants with different motivational profiles. Future research is needed, however, in order to extend these preliminary findings and provide a more comprehensive understanding of the motivational processes underlying high-level performance.</p>
<p>25. <u>Classical pattern recall tests and the prospective nature of expert performance.</u></p> <p>Gorman et al (2012)</p>	Yes	Yes	<p>Sixteen participants were expert basketball players who were current or former regional or national level competitors with an average of 11.8 years of playing experience ($M=20.06$ years of age).</p>	<p>Over the course of several years of practice in a time-stressed environment, an expert team sport performer may have developed the capability to use the features of a pattern to predict the next likely sequence of player movements to a point that is well in advance of a lesser skilled individual.</p>	None provided.	<p>Abstract: Experts' use of an anticipatory encoding process... suggests that many previous investigations may have underestimated the extent of the expert advantage in pattern recall</p> <p>The finding of greatest interest was the evidence showing that the expert basketball players encoded the locations of the elements within the patterns significantly further in advance of their actual finishing point than did the novices, despite being instructed to recall only the last visible location of the elements. This supports previous research using a recognition paradigm...showing that when experts view a structured pattern from their domain of expertise, they view the pattern in terms of its next likely state and intuitively apply an anticipatory encoding process. The present results further demonstrate that an anticipatory representation occurs when the observer's task requires a more holistic processing of the scene, typical of that required in many natural domains.</p> <p>The results of the current study suggest that, as the approach to pattern recall measurement that has been traditionally used may miss some of the essential anticipatory encoding that is characteristic of, and fundamental to, expert performance, further research into prospective coding is a necessary step towards understanding the nature of expert pattern perception.</p>
<p>26. Physical aggression in Australian football: A qualitative study of elite athletes</p> <p>Grange & Kerr (2010)</p>	Yes	Yes	<p>Participants were a unique sample of eight male elite Australian football athletes who had been playing in the AFL from 7 to 15 years. The age range of the participants was 25–34 years ($M \frac{1}{2} 29.5$, $SD \frac{1}{4} 3.3$). All were very experienced athletes and several had received Australian football playing honours.</p>	<p>The rationale behind the study was to use reversal theory as an alternative theoretical approach to those traditionally used in sport aggression research. It was thought that reversal theory might provide a novel way of interpreting athletes' inter-view responses and provide new insights into the types of, and motivation underlying aggressive behaviour at elite levels in sport.</p>	<p>The first author, who was the psychological services manager with the Australian Football League Players Association (AFLPA), requested the views of her work colleagues (including both former and current elite AFL players), and a small group of dedicated fans from various AFL clubs, about who they considered were "the most aggressive players currently in the AFL". There was a high degree of commonality in the athletes nominated which allowed a short list of potential player</p>	<p>This exploratory study into aggression in Australian football produced a number of useful insights from elite athletes at the very top of their sport... The results of the present study have added to the sport psychology literature by focussing on the previously neglected topic of aggression in Australian football, while at the same time showing the usefulness of the four different reversal theory-based categories of aggression in sport for interpreting the interview transcripts.... The findings should only be generalized to other aggressive footballers and other aggressive athletes with considerable caution, given the small sample size.</p>

					interviewees to be drawn up. Following telephone contact, a group of eight athletes renowned for their aggressive play from seven different clubs agreed to take part in the study	
27. Analysis and Description of Olympic Gold Medalists' Competition-Day Routines Grant & Schempp (2013)	Yes	Yes	Elite athletes, by definition, outperform their peers in a superior, consistent manner (Ericsson, 2006) For the purposes of this study, an elite swimmer was defined as earning at least one Olympic gold medal, World Championship gold medal, a world record, or a top-five finish in the world at the conclusion of any single year (Johnson et al., 2008). The participants included five Olympic gold medal-winning male athletes competing at the 2010 ConocoPhillips National Swimming Championships/World Championships and Pan Pacific Championships Qualification meet (2010 Nationals). The participants, who totaled 24 gold, 6 silver, 5 bronze Olympic medals, and 55 world records, represented the most accomplished group of swimmers studied to date	In addition, expertise theory (Ericsson, Charness, Feltovich & Hoffman, 2006) furnishes a rationale for studying elite athletes. As details in numerous works of Ericsson (Ericsson, Krampe, & Tesch-Romer, 1993; Ericsson & Lehmann, 1996; Ericsson et al., 2006), expertise within a domain had specific knowledge, skills, and characteristics that develop through deliberate practice over time. From this perspective, an investigation of elite athletes' actions during a day of competition would provide a framework of possible patterns of behavior that could be used to develop strategic practice for increased performance, which is, in essence, deliberate practice (Ericsson et al., 2006). While organizational routine theory gives clarification to past research and a solid theoretical foundation for the current study, expertise theory supplies a rationale for studying the best swimmers in the world.	Purposeful sampling was used to select participants according to elite performance criteria (Patton, 2002)	Abstract: Utilizing constructivist grounded theory (Charmaz, 2006), a substantive theory of a competition-day routine for elite swimmers emerged. Results suggested that athletes understood all their actions during a competition day as one routine, and research of competitive routines should include both the ostensive (i.e., plan) and performative (i.e., enactment) aspects of routines These results support and help define the substantive grounded theory of elite male swimmers' competition-day routines
28. Perfectionistic profiles among elite athletes and differences in their motivational orientations Gucciardi et al (2012)	Yes	Yes	sample consisted of 423 elite athletes (179 males, 244 females) aged between 14 and 66 (M = 25.64; SD = 8.57). The sports represented included a variety of team (e.g., rowing, hockey, baseball, rugby) and individual sports (e.g., cycling, athletics, triathlon, gymnastics); three participants did not report their sport. Athletes' highest level of competition included the Olympics (n=120) and World Championships (n = 303), with 175 having attained an international title, and 195 having attained a national title. The majority of participants (88%) were highly experienced having competed in their sport for at least five or more years.	the purposes of this paper were to explore the number and types of perfectionistic profiles in elite athlete populations, and what the implications of these distinct perfectionistic profiles may be for motivational orientations. As we focused solely on elite athletes, this study also provided an opportunity to empirically examine the contention that adult elite athletes are characterized solely by adaptive perfectionistic profiles (e.g., Gould et al., 2002).	An information sheet describing the aims and procedures of the project as well as the research proposal was sent to relevant personnel (e.g., director, sport science manager) at each Australian Institute of Sport/Sport Academy and other national sporting bodies (e.g., Hockey Australia, Australian Water Polo).	In summary, the current study has contributed to the conceptualization of perfectionism in sport in several meaningful ways... Based on the current findings, it appears that achievement goals and the aversive achievement motive, fear of failure, but not intrinsic and extrinsic motivation, are central constructs to understanding the functional differences between types of perfectionistic clusters when individual level data are considered (i.e., clusters). More broadly, we hope to have demonstrated the usefulness of person-centered approaches as an important complement to the variable-centered research that dominates the field.
29. Priming of future states in complex motor skills Guldenpenning et al (2012)	Yes	Yes	Twenty students were assigned to the athlete group (nine female, one left-handed, mean age 24.1 years; range 20–31), due to their experiences in high jump (an average of 6.4 years of training in track and field with focus on high jump). The mean training frequency per week for the athlete group (including other sports) was comparable to the non-athlete group (3.7 training sessions per week).	Guldenpenning et al. (2011) argue that the availability of a fine-grained cognitive representation of the high-jump movement in athletes (Schack & Mechsner, 2006) prompts a precise movement anticipation (i.e., within the approach and within the flight phase). In contrast, in novices who lack specific movement expertise, primes activate only coarse representations of future postures of the movement (i.e., the approach is followed by the flight).	Forty participants took part in exchange for pay or in exchange for course credit.	Abstract: Altogether our results suggest that motor expertise results in a more fine-grained posture-based movement representation. In conclusion, the present study demonstrates that domain-specific motor expertise can modulate the processing of a complex movement. As the pattern of results suggests, athletes automatically activate more differentiated representations of forthcoming movement segments than novices do which might be important for the online control of movement execution.
30. The prevalence of failure-based depression among elite athletes Hammond et al (2013)	Yes		The study sample consisted of 28 male and 22 female varsity swimmers at 2 Canadian universities. All were competitors at a national level and qualified to compete at trial competitions for determining Olympic and World Championship teams. Participants were aged 18.2 to 26.7 years, with a mean age of 20.5 years. There were 5 different swimming disciplines of various distances represented,	Very few epidemiological studies have been conducted examining the psychopathology of athletes. It has been proposed that the main reason for this is due to the widespread assumption that only emotionally and mentally strong athletes are able to compete at the highest levels of elite sport. As such, psychological disorders do not exist amid these elite performers. Other studies have suggested that athletic participation was a marker for decreased instance of depression and suicidal ideation.	Athletes were invited to participate in the study via their respective coaches.	Abstract: The findings suggest that the prevalence of depression among elite athletes is higher than what has been previously reported in the literature. Being ranked among the very elite athletes is related to an increase in susceptibility to depression, particularly in relation to a failed performance. Given these findings, it is important to consider the mental health of athletes and have appropriate support services in place.

			including freestyle, breaststroke, backstroke, butterfly and individual medley.	<p>However, the majority of evidence examining elite athletes indicates that depression occurs at a similar or increased frequency as within the general population...It has been hypothesised that managing academics, maintaining health, recovering from injury, facing retirement, coping with success, and managing performance expectations are anxiety are all potential stressors pertinent to elite athletes...It is a common occurrence for elite athletes to experience negative affect and depressive symptoms after failing during competition. When performance goals are not achieved, failure-based negative affect and depression is a distinct possibility.</p> <p>To date, no studies have been undertaken examining the relationship between individual performance results and the prevalence of diagnosed depression within a group of elite athletes...It was hypothesised that the prevalence of a major depressive disorder among these elite athletes would be greater than that reported for the general population...It was (also) theorised that performing below one's potential would hold broad adverse implications for elite athletes, which may lead to the development of a major depressive episode.</p>		In summary, the present study suggests that the prevalence of depression within this group of elite athletes is higher than what has been previously reported in the literature. Aspiring to compete among the world's best athletes may increase an athlete's susceptibility to depression, particularly in relation to a failed performance. Although failure-based depression seems to affect athletes of both genders, female athletes continue to experience depression at increased rates. Given these findings, it is important for coaches, athletic staff, and particularly team psychologists to consider the mental health of athletes and have appropriate screening, monitoring, and intervention support services in place, especially after a failed performance.
31. Alleviation of choking under pressure in elite golf: An action research study Hill et al (2011)	Yes	Yes	Six elite golfers (1 female and 5 males; aged 20–38 years) were invited to take part in the study. Three were professional and the remainder had a low handicap (< 5)...Only two participants, Adam and Chris (pseudonyms) were able to accept the invitation... Both participants were 22 year old male golfers and about to compete in their second year on the professional circuit.	<p>Based on previous series of studies showing that elite golfers choked regularly.</p> <p>Finally, it is important to note that as elite athletes have already learnt their skill and accumulated explicit knowledge, the benefits of implicit and analogy learning are more likely to assist the novice performer.</p> <p>the following study will evaluate longitudinally the effect of an intervention designed to alleviate choking, that has been devised from the findings of Hill et al. (2010a), informed by Hill et al. (2009), and reflects the needs of elite golfers who choke under pressure regularly. Through the use of action research, the intervention was tailored throughout a ten month season to suit the individual requirements of each participant.</p>	Six elite golfers (1 female and 5 males; aged 20–38 years) were invited to take part in the study...All participants choked under pressure regularly and had their choking experiences explored within Hill et al. (2010a). Only two participants, Adam and Chris (pseudonyms) were able to accept the invitation, as the others had either withdrawn from the sport or chosen to perform at a lower standard before the intervention began.	<p>Abstract: The results indicated the intervention alleviated the participants' choking episodes and so provides information that can be of use to practitioners working with golfers who choke.</p> <p>The study has demonstrated that an intervention designed to alleviate choking has effectively reduced the number of choking episodes experienced by two elite golfers throughout a competitive season...The strategies used within the study were collectively responsible for this improvement, emphasizing the need to use evidence based interventions designed to address the specific needs of an athlete population</p>
32. Attitudes, commitment and motivation amongst Icelandic elite athletes Hildorsson et al (2012)	Yes	Yes	<p>The elite athletes in team sports were defined as those athletes who were playing in professional leagues outside Iceland and were also members of the Icelandic national team in their sport at the time of the administration of the questionnaire. In individual sports those athletes who were on the Icelandic Olympic team for Athens 2004 (last Olympics preceding the data collection)...The elite athletes were selected to represent only the individuals that are unquestionable considered to be elite athletes so it can be argued that the results are built on data that is nationally representative.</p> <p>How many?</p>	<p>Lack of research on psycho-social aspects of elite talent identification and development. Need for exploratory research.</p> <p>Success in sporting competition has often been attributed to the physical characteristics of those athletes that do well...less attention has been paid to the social and socio-psychological aspects of success in sport...The aim of this paper is to help fill that vacuum and test whether Icelandic elite athletes, who have reached this desirable level, differ on socio-psychological measures relating to their success from Icelandic second-level athletes who have not advanced to the elite level. Comparing top-level athletes with athletes who have not reached the elite level would provide a test of differences in attitude in the two groups. If the elite athletes score significantly higher than the control group on the scales of commitment and motivation it could indicate that socio-psychological factors are important for individuals sporting success. If not, the opposite could be the case.</p>	The coaches of the athletes in both groups were contacted either by telephone or personally by the author and asked if they agreed that their athletes participate in the study. After the coach had given consent, the athletes were invited to participate.	<p>Abstract: Our findings further indicate that athletes seem to attribute their success in sport to socio-psychological attributes rather than physical and innate ones.</p> <p>The findings...suggest that socio-psychological variables such as commitment and motivation are crucial for success in sport...Our findings demonstrate that nurturing aspects should not be excluded in future research on the making of elite athletes. It is insufficient to focus solely on biological traits at the individual level. The social, social psychological, psychological, and biological aspects area all important when it comes to achievement in sport.</p>
33. Role satisfaction	Yes	Yes	One hundred and ten female senior handball players from 10 different teams in the Norwegian	It should be noted, however, that only a limited number of studies on social loafing have included elite-level	The coaches of all 12 female teams in Posten-	Abstract: In line with the expectations, role satisfaction fully mediated the positive relation between role ambiguity and

mediates the relation between role ambiguity and social loafing among elite women handball players HØIGAARD et al (2010)			elite series took part in the study. The players varied in age from 17.1 to 36.3 years (M = 22.8 years, SD = 4.0 years). The number of years of playing at elite level varied from 4 months to 20 years (M = 3.9 years, SD = 3.6 years), and 16% of the players had been in the national A team in the past 3 years. The number of players per team who took part varied from 8 to 15, with an average of 11 players per team.	performers. Although social loafing is expected to be less prevalent at the elite level, the impact of social loafing at this level can be considered to be more serious because of the greater stakes. Even fewer studies have targeted elite female athletes.	league (elite series) 08/09 were contacted by telephone to ask them if they were willing to take part in the study. Of the 12 coaches who were asked, 10 agreed to participate.	self-reported social loafing: The more players experienced role ambiguity, the less satisfied they were with their role in the team, and the more social loafing they reported. The mediation observed in the present study confirms the suggestion by Jackson and Schuler (1985) that satisfaction is a direct antecedent of commitment, which in turn has been found to predict willingness to exert effort for the group (Ouwkerk et al., 1999), and therefore of social loafing as purported. The findings also support previous research by Beauchamp et al. (2005), who found that clarity about the scope of responsibility was positively associated with role satisfaction... From an applied perspective, the results of the current study are useful both for coaches and for athletes of interactive sport teams performing at elite levels. The results show that social loafing can occur even at this level, albeit at a limited extent... The results of this study show that part of self-reported social loafing can be eliminated by minimizing role ambiguity and role dissatisfaction.
34. Psychological Predictors of Injury Occurrence: A Prospective Investigation of Professional Swedish Soccer Players Ivarsson et al (2013)	Yes	Yes	players (n = 38 male, n = 18 female) competing on 4 different teams in the Swedish Premier League participated in the study. Participants ranged in age from 16 to 36 years (mean = 25.05, SD = 5.46). All were professional, normally practiced 5 to 7 d/wk, and played weekly games for the duration of the 8-month season.	Tacit assumption that professional players experience more injuries and related stress. One sport with relatively high injury rates is soccer. ⁶ For instance, research found that 92% of elite Finnish male and 79% of female soccer players reported at least one injury per year. ⁷ High injury rates have also been found in a Swedish elite sample, with 65% to 95% reporting at least one injury during a single season. ⁸ In addition to an epidemiologic interest in sport injury, high injury rates are of widespread concern to those involved in assisting elite athletes with the psychosocial consequences of injury. A wealth of evidence indicates that sport injury can be an extremely stressful and emotionally disruptive event for elite athletes, particularly in cases where the injury is severe and the athlete is heavily invested in sport. ^{9–11} ... As highlighted herein, the focus of the current investigation was to examine whether specific psychosocial factors could predict sport injuries in a population of professional soccer players.	Coaches and physiotherapists from the participating teams were first contacted by phone, and a meeting was arranged at which they received information regarding the study purposes. At this opening meeting, a schedule for the timing and place of questionnaire administration throughout the competitive season was determined.	Abstract: The findings highlight the need for athletes, coaches, and medical practitioners to attempt to reduce state-level stressors, especially daily hassles, in minimizing injury risk. Educating and training athletes and coaches in proactive stress-management techniques appears warranted. The aforementioned limitations notwithstanding, findings from this study indicate the importance of daily hassles in influencing the relationship between two psychological variables, trait anxiety and negative-life-event stress, and injury occurrence among Swedish Premiere League soccer players.
35. Stress, coping and emotions on the world stage: the experience of participating in a major soccer tournament penalty shoot out Jordet & Elferink-Gemser (2012)	Yes	Yes	The eight male participants all took a kick in the quarterfinal between Sweden and the Netherlands in the 2004 European Championships soccer tournament. Because some of the results of this study are potentially sensitive and all participants are well known in the soccer community, no information that could potentially reveal the participants' identities is disclosed. However, some basic demographic information can be provided about the total population from which these participants were drawn. In total, 12 players took a kick after this game, with the players ranging in age between 20 and 33 years (M = 26.3, SD = 4.8) and having played between five and 79 national team games for their country (M = 35.6, SD = 26.2). In addition, at the time of this event, all players represented major professional European clubs: Ajax (two players), Anderlecht, Arsenal, Aston Villa, Barcelona (two players), Bayern Munich, Manchester United, PSV Eindhoven (two players), and Rennes. In the penalty shootout, nine players scored and three players missed their shot.	feature of top level international soccer. The general purpose of the present study was to shed more light on some of the qualitative aspects related to performing in an event that is so important for the outcome of major tournaments in the global game of soccer. Specifically, the study sought to understand the stressors encountered, the emotions these players felt, and how they coped when taking part in this event.... Although several other studies have been conducted with athletes at a high international level of performance (e.g., participants in the Olympics; Pensgaard & Duda, 2003), there seems to be few published studies of stress and coping in elite athletes playing professionally in major teams sports	The participants' contact information was obtained from personal acquaintances to keypeople in the two teams and all players who were asked to participate agreed to do so. The participants played and lived in various countries across Europe, so the interviewers traveled to their clubs and interviews were carried out at facilities close to the training ground.	In conclusion, this interview study provided detailed descriptions of the experience of stressors, coping, and emotions related to participating in a series of kicks from the penalty mark at the highest level of international soccer. Practitioners can use the results to help elite athletes simulate similar stressful competitive events and cope with the stressors that naturally occur during these events. Moreover, the first-hand descriptions of how players experience taking part in this event provide an important basis for future research, both explanatory, experimental and applied, on the psychology of the soccer penalty shootout.
36. Mindful	Yes	Yes	The participant is an international female top	However, very little is known about recovery from burnout	In mid-January she	Abstract: Mindfulness and Qigong techniques may be useful in

recovery: A case study of a burned out elite shooter Jouper & Gustafsson (2013).			athlete in shooting, with several medals from international competitions	among athletes (Gustafsson et al., 2011). This indicates the importance of valid and reliable measures of recovery and rehabilitation. In addition, knowledge about successful interventions in occupational burnout is sparse. Interventions are based on both individual and organizational approaches (Schaufeli & Buunk, 2003), but changing organizations might be difficult in elite sport and therefore the individual approach might be the most efficient.	phoned the first author and we decided to meet on February 8;	the prevention of and recovery from athlete burnout It should be kept in mind that this participant is only a single case without a control group, and results may also have occurred after a period of rest. These results cannot be generalized to a common athlete burnout recovery strategy or guidelines for groups of athletes (Yin, 2003). In conclusion, this sufferer from athlete burnout recovered from exhaustion, fatigue and frequent fever reactions, and improved her psychological feelings of energy and primordial force as well as sport functioning by adding mindfulness and Qigong techniques to her daily exercise routine.
37. British Olympic hopefuls: The antecedents and consequences of implicit ability beliefs in elite track and field athletes Jowett & Spray (2013)	Yes	Yes	The participants comprised 4 elite level track and field athletes (1 male & 1 female sprinter; 1 male & 1 female thrower) aged between 21 and 28 (M $\frac{1}{4}$ 25.5 SD $\frac{1}{4}$ 3.11). They had an average of 6.25 (SD $\frac{1}{4}$ 1.71) years of experience competing at an international level and were regarded as Olympic hopefuls, currently aiming to qualify for the Great Britain team in London 2012. Specific to this study, the criteria for being classed as an elite level athlete included representing Great Britain as a senior athlete and participation in at least one major international event/games e.g. World Championships, European Championships. Additionally, to establish an element of consistency between the standard of the participants, all of the athletes selected were finalists in the 2010 Commonwealth Games (though one athlete was unable to compete due to injury).	Essentially, individuals' implicit beliefs about ability can impact on their feelings, thoughts and the way they behave. In elite sport, these beliefs may be a significant contributory factor to athletes' performances and, ultimately, their sporting careers. According to Wang and Biddle (2001), the extent to which an individual holds an entity or incremental belief may also have significant consequences for goals, motivation, enjoyment, and effort in sport and physical education. Consequently, these beliefs may have extremely important outcomes for elite athletes and could exert a significant influence on their sporting performance.	Following ethical approval, potential participants were contacted either in person or via email or telephone.	Abstract: The results from the analysis indicated that the athletes' implicit beliefs were very specific, as their beliefs about ability appeared to underpin sport-specific performance. The belief that ability was malleable was universal amongst the athletes and this may be related to their age, experience, high perceived ability and the high level at which they compete. However, the athletes believed that although natural ability is useful, talent is only a small part of the equation as learning, improving and working hard are all necessary for success at the highest level. This paper has provided insight into the motivational processes of elite athletes by enabling an in-depth examination of the core components, antecedents, and consequences of implicit beliefs.
38. The experience of losing: Qualitative study of elite lacrosse athletes and team performance at a world championship Kerr & Males (2010)	Yes	Yes	The participants in this study were four volunteer elite male lacrosse players who were members of a national team playing in a world lacrosse championship tournament. The participants were a valuable group of different playing positions and experience at international level. The four were: a 30-year-old defender, with eight years international experience; a 28 year-old attacker, who had two years international experience; a 27-year-old "shortstick" midfielder, with four years international experience; a 22-year-old "longstick" midfield player and vice-captain of the team, with six years international experience. Three participants were playing in their first world lacrosse championship tournament, but the vicecaptain was playing in his second	While athletes generally strive for and enjoy improved performances, even the most successful athletes have first-hand experience of losing in competitions and most athletes have to learn to deal with losing as they progress through the different performance levels towards eventually achieving elite athlete status... Psychology databases (e.g., EBSCOhost Research Databases) and sport psychology journal searches reveal that sport psychology research on elite athletes has tended to concentrate on successful athletes and winning performances at the expense of studying unsuccessful athletes and losing performances... There are several likely reasons why this has occurred, including: (a) researchers wanted to acquire knowledge of successful athletes' psychological experience so that it could be applied to enhance performance in other athletes and teams (b) elite-level athlete participants in research investigations may have been less willing to complete questionnaires or engage in interviews after losing than after winning performances; (c) investigating successful elite athletes and teams may have been a more attractive proposition for researchers than investigating unsuccessful performance and losing teams. In general, it appears that there have only been a few studies in the extant sport psychology research literature which have investigated less successful or losing elite athletes and teams and the psychological changes that accompany underperformance and losing	The second author, an experienced practising sport psychologist and qualitative researcher, made contact with the head coach and explained the research rationale. The head coach subsequently agreed that the research could take place. Written information was then sent out to players describing the research. Four players volunteered to participate	Abstract: The findings direct attention to possible causal factors for motivational reversals, allowing subsequent studies to start with a number of known focus areas. What is widely applicable and able to be generalised from the study is the attention that the findings direct on possible causal factors for motivational reversals. These factors allow subsequent studies to start with a number of known focus areas. Within each area, the range of individual responses may vary, but it is very likely that there are highly predictable patterns (e.g., substitution without obvious rationale, an external contingency, will create frustration and anger to players in a teleconformist state combination). Losing is never easy in elite sport, nor should it ever be readily accepted. The challenge for developing teams is to pursue victory even against superior opponents and to draw consolation in defeat through the knowledge that team preparation, communication, tactics and delivery were as professional as possible. With the correct attitude from coaches, team management, and sport psychology support staff, losing can be perceived and used in a positive way to: "develop a team 'culture' that recognises, values and utilises the experience of loss in the pursuit of excellence." (Reid, 2004, p.189).
39. Using segmentation to support the	Yes	Yes	A group of 24 novice male soccer players and a group of 24 expert male soccer players volunteered to participate in the experiment. The	The aim of the present study is to investigate the effectiveness of different forms of segmented animations in learning a sequence of play in soccer. An important part of this aim is to	None provided.	Abstract: Study results suggested that adapting instructional animation formats to players with different levels of expertise should be a crucial part of successful training.

<p>learning from animated soccer scenes: An effect of prior knowledge</p> <p>Khacharem et al (2013)</p>			<p>experts ($Mage \frac{1}{4} 25.84$, $SD \frac{1}{4} 3.2$) were all professional soccer players who had been playing on a top-level team engaged in a national competition. They had been playing soccer for an average of 12.7 years ($SD \frac{1}{4} 2.0$) for an average of 45 match competitions ($SD \frac{1}{4} 3.29$) per year and trained or played for an average of 9.54 h ($SD \frac{1}{4} 1.58$) per week.</p>	<p>establish whether the effectiveness of segmentation is influenced by levels of learner prior knowledge (levels of expertise).</p> <p>According to the studies mentioned above, the effectiveness of the learning process is dependent not only on the presentation form of the animation, but also on the learners' level of expertise in the field. To investigate the potential interaction between these two factors, we used soccer game activity, and particularly a counterattack scene.... It was hypothesized that expert soccer players who had already acquired domain-specific knowledge to deal with extraneous cognitive load induced by transient animation (Kalyuga, 2008; Spanjers et al., 2011), would perform at the same level, invest the same amount of mental effort and need the same number of repetitions regardless of the type of presentation. However, novice soccer players would benefit from the segmented animation by either achieving higher recall scores, investing less mental effort, requiring fewer repetitions during learning, or demonstrating a combination of these.</p>		<p>In general, the results demonstrate that, regardless of the format used to present the animated soccer scenes, the experts demonstrated higher efficiency than the novices, that is, they obtained better recall scores, invested less mental effort and needed less repetition. This is consistent with previous studies on expertise demonstrating the superiority of expert soccer players in memorization and/or decision-making tasks when they are tested with realistic, sport-specific tasks</p> <p>In summary, this study underlines the benefit of employing different forms of segmentation in improving learning from an animated soccer scene, as well as the need to consider levels of player expertise when selecting appropriate forms of segmentation. Novice players may benefit more from micro-step segmentation than from macro-step segmentation or no segmentation and more from macro-step segmentation than from no segmentation, while expert players may benefit similarly from both types of segmentation.</p>
<p>40. Effect of presentation format and expertise on attacking-drill memorization in soccer</p> <p>Khacharem et al (2013)</p>	Yes	Yes	<p>The participants in the expert group ($Mage = 26.2$ years, $SD = 1.9$ year) were selected on the basis of the following criteria: (a) playing level (semi-professional), (b) playing experience in number of years ($M = 13$ years, $SD = 1.6$ year), (c) number of competition matches per year ($M = 43$, $SD = 5$), (d) number of practice sessions per week ($M = 8$, $SD = 2$), and (e) number of hours of practice per week ($M = 11$ hr, $SD = 1.3$ hr).</p> <p>How many?</p>	<p>The ability to understand and memorize a complex soccer drill is central for successful performance in a competition match. Before and after a match, coaches give their players drills to learn, review, or perfect. To help them learn the strategies and tactics depicted in the drills, coaches provide pictorial demonstrations that are static (e.g., diagrams sketched on a blackboard) and/or dynamic (e.g., videos, animation). To use these pictures, soccer players, whether experts or novices, must carry out various highly complex cognitive operations, and if the presentation is not in keeping with the players' level of comprehension, it may be totally ineffective (Ripoll, Zoudji, & Lucia, 2009). Indeed, to understand and use such demonstrations, players must be capable of building and storing a mental representation of the actions they will have to perform later when on the field. The present study aimed to identify the presentation format most likely to promote optimal memorization of a play in team sports. Two questions oriented our work: (a) What format will lead to the best understanding of an attacking drill in soccer? (b) Does the efficiency of a format depend upon players' level of expertise?</p> <p>Another factor affecting the intrinsic load is the participant's level of expertise...The very same material may represent a lighter intrinsic cognitive load for experts than for non-experts. Thanks to their domain-specific knowledge, experts are capable of using chunking strategies to cognitively group together several independent items into a single large and easy-to-activate unit. This enables them to reduce the intrinsic cognitive load, and thus, to better understand and memorize a scene or situation.</p> <p>It was hypothesized that there would be a significant interaction between level of expertise and presentation format (i.e., an expertise reversal effect).</p>	None provided	<p>Abstract: Results indicated (a) that novices benefited more from the static than dynamic format, while expert players benefited more from the dynamic than static format; and (b) a negative effect of the combined format on the learning process of the two groups. Findings suggest the need to adapt the presentation format to players with different levels of expertise.</p> <p>To sum up, this study suggests that adapting presentation format to players with different levels of expertise should be an indispensable part of efficient tactical learning.</p>
<p>41. Transcontextual development of motivation in sport injury prevention among elite</p>	Yes	Yes	<p>Participants were 533 elite athletes ($Mage = 16.79$, $SD = 2.80$; 50.30% male) recruited from eight elite-sport training centers within the Sichuan Province of China. They were either regional level (15.00%), national level (70.70%), or international level (11.6%) athletes from 13 different sports (16.32% swimming, 15.38%</p>	<p>in the sport injury context, studies have provided preliminary support for the relationship between perceived autonomy support provided by a sports team's physician and athletes' self-determined motivation and adherence to sport injury rehabilitation (i.e., a pivotal element for the prevention of reinjury in sport; Chan, Lonsdale, Ho, Yung, & Chan, 2009). There is also support for the association between self-</p>	<p>Participants were 533 elite athletes ($Mage = 16.79$, $SD = 2.80$; 50.30% male) recruited from eight elite-sport training centers within the Sichuan Province of China.</p>	<p>Abstract: In conclusion, the transcontextual mechanism of motivation may explain the process by which distal motivational factors in sport direct the formation of proximal motivation, beliefs, and behaviors of sport injury prevention</p> <p>In conclusion, our study presented a preliminary test of the dispositional, psychosocial, and motivational processes</p>

athletes King-Chung Chan, & Hagger (2012).			athletics, 15.01% soccer, 9.94% gymnastics, 6.94% cycling, 6.75% badminton, 5.81% volleyball, 5.25% canoeing, 4.88% diving, 4.32% tennis, 4.13% basketball, 3.56% rowing, and 1.69% windsurfing). Athletes had received elite training in their sport for more than 1 year (training years, $M = 3.23$, $SD = 2.15$).	determined motivation, intentions, adaptive social cognitive beliefs with respect to injury-preventive behavior in sport (Chan & Hagger, 2012) and occupational settings (Chan & Hagger, 2011). However, no previous study has simultaneously tested the links between perceived autonomy support from the coach and self-determined motivation in sport and injury prevention contexts among elite athletes. The study will make an original contribution to the literature not only by bringing forth a preliminary test of SDT for sport injury prevention among elite athletes, but also by testing the transcontextual mechanism of injury-preventive motivation with the inclusion of basic need satisfaction, which is unique to the existing literature concerning health and safety (Chan & Hagger, 2011).		associated with sport injury prevention. Results revealed that general causality orientation predicts the psychological components of the proposed transcontextual transfer of motivation, and athletes' self-determined motivation in sport is related to the endorsement for motivation in a different, but related, sport context. Thus, the associations between motivational factors at the global, contextual, and specific levels of generality convey important information for sport policy, team management, and coaching strategies to build up an injury free environment for athletes.
42. A temporal examination of elite performers sources of self-confidence Kingston et al (2010)	Yes	Yes	The participants ($N = 54$) consisted of male ($N = 29$) and female ($N = 25$) elite individual sport performers. The sports included; karate ($n = 8$), diving ($n = 7$), judo ($n = 7$), badminton ($n = 6$), table tennis ($n = 5$), cycling ($n = 4$), mountain running ($n = 3$), athletics ($n = 2$), ice skating ($n = 2$), motor racing ($n = 2$), pistol shooting ($n = 2$), trampolining ($n = 2$), triathlon ($n = 2$), artistic roller skating ($n = 1$), boxing ($n = 1$). All performers were currently competing at an international level. The age of the performers ranged from 18 to 51 ($M = 24.59$, $SD = 6.99$), and had an average of 11.25 ($SD = 6.53$) years competing in their sport.	Griffith (1925) proposed that research should be conducted using experienced and successful athletes in order that findings could be applied to less successful sport participants.	Following initial discussions with coaches and/or organizational representatives, potential athletes were approached before their normal training sessions. Participants were informed that the researcher was interested in understanding more about their confidence in the build up to an important competition, and then were given the opportunity to ask any questions concerning the research project. The sample could be viewed as a convenient sample of elite performers because the nature of the research design required participants to be working toward a "major" competition (e.g., Olympic trials).	In summary, this study highlighted the importance of examining elite athletes' sources of sport-confidence during the build up to a major competition. Results illustrated that demonstration of ability, physical/mental preparation, physical selfpresentation and situational favorableness sources of sport-confidence fluctuated during the precompetition period for elite athletes.
43 <u>IMAGERY USE OF ATHLETES IN INDIVIDUAL AND TEAM SPORTS THAT REQUIRE OPEN AND CLOSED SKILL.</u> KIZILDAG & TIRYAKI (2012).	Yes	Yes	elite turkish athletes (87 male, 64 female) from both individual opens kill (tennis $n=26$, 17 male, 9 female) and individual closed-skill sports (track and field $N=34$, 20 male, 14 female; swimming $N=25$, 16male, 9 female) and team open-skill sports (volleyball $N=39$, 21male, 18female; basketball $N=27$, 13male, 14female) voluntarily participated in the study. Athletes were 15 to 33 years old ($M=20.4$, $SD = 3.3$), and the length of competitive experience ranged from 4 to 20 years ($M=8.9$, $SD=3.2$). For present purposes, athletes who represented Turkey at international competitions (European and World Championships or Olympic games) were considered elite athletes	None – subtly implied at best Arvinen-Barrow, Weigand, Thomas, Hemmings and Walley (2007) investigated imagery use by elite and novice athletes in open and closed sports. Elite athletes used significantly more cognitive specific and cognitive general imagery than novice athletes; athletes in open-skill sports used significantly more motivational general-arousal imagery than athletes in closed-skill sport. Arvinen-Barrow, Weigand, Hemmings, and Walley (2008) also focused on the use of imagery at various competitive levels in skating. Their results indicated that senior skaters used more cognitive specific, motivational general-arousal, and motivational general-mastery imagery than junior skaters.	The coaches were contacted to request permission to contact their respective individual and team athletes for the research project.	It is clear that there may be patterns of imagery use across types of sports, but that there are many interactions as well as a great deal of variability. While the current research supports some prior findings, the relationship between imagery use and the type of sport, type of skill (open or closed), and other factors require much closer investigation to identify the patterns. It may also be that there is such a large amount of individual variation among athletes that it overwhelms larger patterns across the sports.
44. Sports-related correlates of disordered eating in	Yes	Yes	Athletes from aesthetic sports from six different German sports institutions with high-performance levels such as elite sport schools or Olympic training centers were selected. 96 athletes (61 girls, 35 boys) between 11 and 18	high rates of disordered eating occur in elite-sports where competition results depend on judges' opinions and aesthetic evaluation, as in gymnastics, figure skating, diving, and dancing... Heterogeneity in the effect found by Smolak et al. (2000) raises the question of which elite	Athletes from aesthetic sports from six different German sports institutions with high-performance levels such	Abstract: The results suggest that sports-related parameters are relevant for understanding eating disorder symptomatology in aesthetic sports. Athletes from aesthetic sports seem to be more at risk if they perceive the possibility to enhance sports performance through weight-regulation, which appears to be

aesthetic sports Krentz & Warschburger (2011)			years of age filled in a questionnaire during or after a training session. Types of sports included were ice figure skating (n¼30), gymnastics (n¼25), ballet (n¼15), roller-skate figure skating (n¼11), diving (n¼12), and rhythmic gymnastics (n¼3).	athletes in aesthetic sports are more vulnerable than others. Research on factors that might trigger disordered eating in such sports at a high-performance level need to consider the demands of the specific sport discipline... It might be necessary to consider another type of body dissatisfaction for elite athletes which refers to the ideal for participating in the specific sporting discipline (Dosil, 2008).	as elite sport schools or Olympic training centers were selected.	triggered by social pressure to be lean from sports environment. Previous studies have indicated higher rates for disordered eating in aesthetic sports, especially for high-performance levels...We confirmed this in the present study with a significantly higher mean for eating pathology in our sample of German elite athletes from aesthetic sports as compared with a non-athletic control group. As most of the earlier studies focused on female athletes only, we emphasize that this effect was found true for both genders. Though the effect size was small, indicating that disordered eating is only somewhat elevated in athletes from aesthetic sports.
45. Coping with the media at the Vancouver Winter Olympics: "We all make a living out of this" Kristiansen et al (2011)	Yes	Yes	10 Norwegian winter Olympians with media experience... The participants were all in their 20s and beginning of the 30s (Mage = 27.7 years, SD = 4.41) and half of them had previous Olympic experience. It was a very elite sample; the Norwegian Olympic team took 23 medals during the Olympics in Vancouver, and our participants were involved in 13 of them; five gold, four silver and four bronze medals.	The purpose of this study was to investigate how Norwegian Winter Olympians experienced the intense media presence and the interaction with journalists and the media reports that emerged.	None provided.	(T)he evidence from the present investigation demonstrated that the journalist-athlete relationship was a potential source of strain for Norwegian Olympic athletes before and during the 2010 Vancouver OWG... But the fact remains: The media acts as a source of real stress during major competitive events that are avidly followed by spectators around the world. When the media is present to ask questions that range from the trivial to the intensely private, it is no wonder some athletes find it stressful and avoid them as much as possible.
46. Organizational and media stress among professional football players: testing an achievement goal theory model. Kristiansen et al (2012)	Yes	Yes	Participants were 82 elite football players (Mage525.17 years, SD55.19). Three different professional male teams in a Premier Division in Europe were contacted with the help of the national Football Association. As in any Premier Division of professional football in Europe, there were international players from several countries in the teams. Many of the players had experience with their respective national teams.	Pensgaard and Roberts argue that an elite athlete's perception of stress is related to the perceived motivational climate and in order to reduce the perception of stress, the coach should focus on creating a mastery climate for elite athletes. Even elite athletes prefer their coaches to have a more mastery approach to performance because it alleviates stress (Pensgaard & Roberts, 2002).	The athletes were willing to participate after the purpose of the investigation was given by the first author after a practice session, and they then completed a questionnaire package. Informed consent was obtained from all participants and the investigation was conducted in accordance with ethical research guidelines.	Abstract: These findings support some of the key postulates of AGT; a mastery climate reduces the perception of stress among athletes, and the converse is true for a performance climate. Coaches of elite footballers are advised to try to reduce the emphasis on performance criteria because of its stress reducing effects. The findings of this study suggest that a motivational approach to perceived strain in football may combat and reduce the quantity, frequency, and/or intensity of coach-athlete and media stressors. Being able to cope with perceived stress is an important part of playing elite football.
47. Media exposure and adaptive coping in elite football Kristiansen & Roberts (2011)	Yes	Yes	Participants were 82 elite football players (M age = 25.17 years, SD = 5.19). Three different professional male teams in a Premier Division in Europe were contacted with the help of the national Football Association. As in any Premier Division of professional football in Europe, there were international players from several countries on the teams. Many of the players had experience with their respective national teams.	An understudied topic in sport psychology research is the impact of media coverage on elite athletes...Given the huge media coverage of elite sport, research into the impact of this environmental stressor on athletes in our modern, globalised society on sportsmen and women is needed. Nowhere is this global media coverage so evident as in the Olympic movement, and especially, world football...Therefore, an investigation on how elite athletes cope with media coverage seems to be warranted.	Three different professional male teams in a Premier Division in Europe were contacted with the help of the national Football Association...The teams were visited after morning training when they were gathered to eat lunch in the beginning of the season. The athletes were willing to participate after the purpose of the investigation was given.	Abstract: Both individual coping strategies and team coping (mastery climate) seemed necessary to keep and protect a stable self-confidence among the football players and maintain team effort to perform. From the evidence reported above, the role of the coach in keeping the motivational climate within the team as mastery oriented as possible is an investment in team coping with media reporting (as well as individual coping). This is in accord with Pensgaard and Roberts (1992) who found that in the case of elite individual sport athletes, the coach focusing on mastery criteria before important events in the Olympics reduced the perception of stress. Clearly, media attention can be highly stressful, and players need to learn how to cope with the attention. As a result, athletes, and especially team athletes (Park 2000) need to demonstrate a range of coping strategies to keep performing at one's best during an entire season and to avoid the different distractions. IN addition, as revealed in the interviews, team coaches and administrative leaders should avoid making the same mistakes as the media by being too focused on outcomes (winning games and championships). The paradox is that in order to win, the focus should not be on winning but on the tasks the

						players have to complete in order to place themselves in the position to be successful. IN addition, the coach should be a source of social support and protect the team from negative media attention and be able to put the media exposure into perspective.
48. Coaching communication issues with elite female athletes: Two Norwegian case studies Kristiansen et al (2012)	Yes	Yes	Two Norwegian elite female athletes with international success volunteered to take part in this investigation. We call them <i>Hazel</i> and <i>April</i> . Today, Hazel is in her mid-30s, a Winter technical sport athlete with several international championships and is still pursuing her athletic career with continued success. April, on the other hand, is now in her late 20s, has retired from competitive participation and is currently pursuing a coaching career and is a student. She used to be a Summer sport endurance athlete with several medals at the highest international level.	As the coaches of elite athletes are expected to coordinate the communication between the different parties and to plan and prepare for long-term development and participation in elite competition (Lyle & Cushion, 2010), both depth and breadth of knowledge in the sport sciences is needed... An important aspect of the coach–athlete relationship is to produce enhanced performance and success in elite competitions. Of course, this does not always occur, but when it happens, the athlete perceives success and becomes committed to the sport. However, the success and subsequent commitment also mean that the athlete is subjected to a strenuous training regimen induced by professional coaches of the sport. The demands and the perceived effort it takes to maintain that successful performance over time may become sources of strain for the athlete. The initial motivation may have been to demonstrate competence and the enjoyment that comes from achieving performance goals, but when the athlete is admitted into an elite training regimen, the heavy training program may sap the initial enjoyment. In a worst-case scenario, competing becomes a negative experience and may lead to conflict with the coach. A breakdown in communication may occur and negatively impact performance (Greenleaf et al., 2001)... The aim of the current investigation is to empirically explore how two elite female athletes perceived a breakdown in communication with their respective coaches when they were recruited into the elite sport coaching program in their sport. The purpose of the present study was twofold: (a) to tell the stories of two prominent, talented, and successful female athletes who experienced initial success and were celebrated for their international medals. Unfortunately, they both started to struggle after the first flush of fame when they were recruited into the enhanced training regimen of their sport. The stories reflect how they perceived the coaching they received and the communication process with the coach; and (b) to determine those physical, organizational (team, NGBs, and Olympic committees), and psychological factors that impinged on coaching elite female athletes from the athlete’s point of view.	None provided	Abstract: The coach–athlete relationship was discussed with a focus on the inexperience of some coaches, the number of coaches the athletes had to deal with, sociolinguistic issues, and the differing criteria of success communicated. Finally, the importance of their national governing bodies to focus on knowledge transfer, the supervision of coaches, and the infrastructure to monitor athletes were discussed. We aimed at providing insight into the subjective experiences of two elite female athletes. When they were embraced by their respective NGBs and were given expert coaches, their athletic achievements deteriorated when they should have improved. Moreover, we examined in-depth the negative effect of miscommunication in these two cases. However, we were not to be able to generalize from these findings which are a clear limitation (Stake, 2005).
49. Emotional and motivational uses of music in sports and exercise: A questionnaire study among athletes Laukka & Quick (2013)	YES	YES	A self-administered electronic questionnaire was sent to 438 Swedish athletes who practiced various individual sports on a national or international level. Table 1 presents the characteristics of the sample in terms of various background variables obtained in the questionnaire; 252 athletes (135 women and 117 men; mean age = 23 years; response rate = 58%) participated in the study.	There are many case reports of famous athletes who have used music to enhance their performance... Empirical investigations on the how’s and why’s of listening to music in sports remain scarce, but are important for gaining a better understanding of the potential benefits of music in sports. In the present study, we therefore report results from a questionnaire study focusing on elite athletes’ emotional and motivational uses of music in sports and exercise.	The participants were contacted using e-mail and were asked if they would like to participate in a survey concerning uses of music in sports. The addresses were provided by various national athletic associations and sports clubs, as well as social networking websites. The prospective participants were informed about the goal of the study, that their participation would be	Abstract: In general, the results suggest that the athletes used music in purposeful ways in order to facilitate their training and performance. To summarize, the main results suggest that athletes often listen to music, and believe music to be important, in everyday as well as in sports settings. During sport, both semantic and episodic estimates suggested that the athletes most often listened to music during pre-event preparations, warm-up, and training, and less frequently during competition or after the event. The most frequently reported motives for listening to music in sports were to increase levels of activation, motivation, performance and positive affect. The athletes further reported that they mainly experienced positive affective states (e.g., alert, happy, calm/relaxed, confident) in relation to music in sports. These results extend previous findings which have mainly been based on qualitative interviews with few participants (e.g., Bishop et

					confidential, and that data would only be used for scientific purposes.	al., 2007), and suggest that emotional and motivational uses of music are an integral part of both training and preparation for competition for many athletes... The present study expands upon earlier qualitative studies and provides the first estimates of the prevalence of various emotional and motivational uses of music among elite athletes.
50. Predictors of doping intentions in elite-level athletes: A social cognition approach Lazuras et al (2013)	Yes	Yes	<p>Anonymous questionnaires were given to Greek elite-level athletes from nine different sports (football, basketball, volleyball, handball, athletics, swimming, shooting, Tae Kwon Do, and rowing). Sports teams (for team sports) and clubs (for individual sports) were randomly selected from the databases of each sports federation. Further on, participants from the selected sports teams and clubs were recruited based on the following criteria: participation in professional leagues (A1 for basketball, volleyball and handball teams and Superleague for football teams) and systematic training for the past 5 years (for athletes in team sports); participation in the finals of the national and/or international championships during the past 5 years (for athletes in individual sports).</p> <p>This final sample consisted of athletes from both team (63.6%, or n = All) and individual sports (36.4%, or n = 273). Mean age was 25 years (SD = 5.89), and 63.9% of the participants were males.</p> <p>How many?</p>	relevant research in professional or elite athletes is still lacking, thus leaving a gap in our knowledge regarding the influences on doping use in more advanced levels of sports.	Sports clubs were contacted and the aim of the project was described to the administrative board and the coaches. Following the permission of the administrative board and coaches, athletes were briefed about the project, and informed consent was requested from those wishing to participate.	<p>Abstract: The findings provide the basis for future social cognition research in doping use, and set the framework for the development of evidence-based preventive interventions.</p> <p>(T)he present findings suggest that attitudes play an important role in shaping doping intentions. The findings also indicated that past and current doping behaviour strongly predicted doping intentions, and, therefore may be predictive of future behaviour...This is in line with previous studies showing that past or current behavioural choices predict both intentions and future actions.</p> <p>(NB: There are other sentences similar to the above too)</p> <p>Overall, the findings of the current study identify interesting processes underlying doping intentions and behaviour.</p>
51. Real-time communication during play: Analysis of team-mates' talk and interaction. LeCouteur & Feo (2011)	Yes	Yes	Materials for analysis were video and audio recordings of three netball matches involving players training at the South Australian Sports Institute (SASI). SASI supports elite, world- championship level athletes competing at an international level, and junior elite athletes who compete on a national scale. The netball program involves elite players who train as cohesive team units, and includes national team representatives training seven days a week under the direction of a full-time professional coach. Defensive segments of play within recorded matches were the focus of analysis. Consent of players to the taping of their games was obtained. Such recording for the purposes of measurement of player performance is standard practice at the Sports Institute, and as such, it is assumed that participating in this study was unlikely to alter the team's usual communication practices.	Defensive segments of play within recorded matches were the focus of analysis. Consent of players to the taping of their games was obtained. Such recording for the purposes of measurement of player performance is standard practice at the Sports Institute, and as such, it is assumed that participating in this study was unlikely to alter the team's usual communication practices.	None provided.	<p>Abstract: In addition to advocating for the maintenance of high frequencies of communication, it is recommended that coaches and players also turn attention to the specific practices by which players communicate about problematic features of unfolding play. We suggest specific ways in which players might be encouraged to design their communications to allow team-mates increased opportunity to notice and act upon particular events in the complex, fast-paced, highly contingent environment of actual play.</p> <p>initial descriptive statistics based on the coding of players' behaviour illustrated that high frequencies of oncourt talk occurred during less successful performance outcomes.... In the present study, qualitative analysis of recurrent communicative practices used by elite netballers to attempt real-time collaboration during defensive play presented evidence suggesting that standard coaching and motivational instructions for teams to 'talk it up' during play may not be the best means of encouraging improvement in the co-ordinated activity of members. It is not merely 'more' communication that is required to ensure effective collaboration between players who are engaged in complex, fragmented, highly contingent, real-time activities; it is demonstrably also the nature and quality of the communication that is important... The analysis provided here suggests that specific communicative features of players' verbal and visual conduct are</p>

						important for encouraging successful collaborative activity between teammates. In particular, aspects such as gaze, gesture and orientation can be critical in determining whether problem noticings are speedily oriented to, discriminated, and acted upon, and thus result in successful defense. What we have demonstrated by this application of Conversation Analysis to instances of real-time communication and interaction in sport is that some occasions of defensive failure during play can be traced back to particular patterns of communication, rather than to a lack of communication. Our analysis indicates strongly that it is unlikely to be sufficient for coaches and players to advocate the importance of greater frequency of on-court/on-field communication in order to encourage players towards improved collaboration in defensive play.
52. Health and doping in elite level cycling Lentillon-Kaestner et al (2012)	Yes	Yes	Eight of participants were young current elite-level cyclists and eight were former professional cyclists. The eight former elite-level cyclists become professional before the 1998 Festina Scandal and were no longer professionals when they were interviewed. Some of them had remained in the cycling environment as coaches or personal or team managers. The eight current cyclists were selected from the best young elite-level cyclists in Switzerland. They were all of Swiss nationality with French as their native language and were in transition from amateur to professional level. Six of them were in the men under 23 (U23) category and hoped to find a professional team in the near future. Two of them had already found a professional team (neo-professional): one of them had been professional for a little over 1 year and the other for 3 years. All of them were, or had been, on the national team [junior or U23 (The UCI provides a number of definitions of cyclists. Racers who are 17- or 18- year-old are part of the "junior" category. Once they reach 19 years of age, the cyclists are part of the "amateur" category. The amateurs obtain points based on their standings in races. If they attain sufficient points, they achieve the category "elite." The elite racers who aged 19–22 years are classified in the category 'U23' (o23 years))]. The reason for the small, relatively exclusive sample of 16 cyclists was due to our selection criteria of targeting cyclists of the highest level in the French part of Switzerland.	In elite-level cycling, the use of banned substances is widespread. Over the past few years, a series of doping scandals and cyclists' confessions... have shown that doping was common practice among professional cyclists at least until the Festina Scandal in 1998 The aim of this study is to evaluate how perceived health risks influence the choice to use banned substances among the cyclists... The study suggests that health risks have little impact on doping decision-making among a high proportion of elite-level athletes. However, a number of questions remain; do elite-level cyclists consider the negative consequences of substance use to their health? How are these health risks generally represented by elite-level athletes in the cycling "culture?" It seems necessary to understand the influences on decision making to use banned substances in sport in order to better understand the reasons of their usage and improve prevention measures.	A list of present and former elite-level cyclists of the French part of Switzerland was drawn from cycling websites. These cyclists were contacted by phone (phone numbers were found on their personal websites or on the Swiss online telephone directory) and an overview of the research was presented, focusing not exclusively on doping use but on the understanding of various aspects of a cyclist's career including: training, substance use, health management, family support, difficulties, and so on. Cyclists contributed to this research on a voluntary basis. All of the 16 cyclists asked to participate agreed to take part in the study.	Abstract: There is a need to implement more effective preventive programs to change athletes' attitudes toward doping and its health risks. In summary, results from the present set of interviews with former and actual cyclists suggested that the perceived benefits of the use of banned substances outweighed the perceived health risks. In addition, there was also a trivialization of the health risks and side effects of the use of banned substances in the cycling. Finally, the young cyclists interviewed tended to live in the present and were not concerned about the long-term health consequences of substances used. Instead, they seemed more focused on the short-term positive consequences of the substances use such as improving their performances, helping them achieve excellence, combating fatigue, and winning races. It is necessary to remain cautious concerning the transferability of these findings to international cycling or elite athletes in general. The particular organization of sport within Switzerland and the supervision of the cyclists may have a powerful influence on doping temptations and behaviors among elite and subelite cyclists (Brissonneau et al., 2009). However, these data provide an important overview of the changes that have occurred over the last decade in doping practice, the trivialization of health aspects of doping, and the continued practice of doping
53. Temporal Ordering of Motivational Quality and Athlete Burnout in Elite Sport. Lonsdale & Hodge (2011)	Yes	Yes	New Zealand Academy of Sport athletes (N = 571) were sent an e-mail in which they were invited participate...The mean age of the participants who responded at both time points was 24.74 yr (standard deviation = 8.54 yr, range = 14–53 yr, 78.15% between 18 and 35 yr), with females (n = 68) outnumbering males (n = 51). Athletes came from 17 different sports including individual sport participants (n = 57), team sport athletes (n = 24), and participants whose sport was not easily categorized as team or individual (e.g., rowing, sailing; n = 38). The majority of athletes (67%) had represented New Zealand at the senior national level. Other athletes	None provided.	New Zealand Academy of Sport athletes (N = 571) were sent an e-mail in which they were invited participate; 343 athletes (60.01%) provided informed consent and responded to the online survey.	Abstract: Low levels of self-determination may lead to increases in athlete burnout, whereas athlete burnout may precede decrements in self-determined extrinsic motivation. Particular efforts could be made to help support the basic psychological needs of athletes with controlled forms of motivation, thereby leading to an internalization of motivation and decreased risk of burnout. Despite these limitations, our investigation has implications for those involved in elite sport. Results indicated that low levels of overall self-determination and, in particular, the presence of controlled motivation were antecedents of increased athlete burnout. As a result, understanding athletes' motives for

			were senior provincial, junior national, and junior provincial representatives. The mean duration of participation at their current level was 3.89 yr (standard deviation = 2.79 yr).			participation at the beginning of a season may help identify those who are at risk of increased burnout as the season progresses. Particular efforts could be made to foster autonomy-supportive coaching climates to support these athletes' basic psychological needs for autonomy, competence, and relatedness (21), thereby leading to an internalization of motivation and, hopefully, decreased risk of burnout.
54. Expertise differences in a video decision-making task: speed influences on performance Lorains et al (2013)	Yes	Yes	Eighty-five males aged between 18 and 30 years, with a mean age of 23.23 years (SD $\frac{1}{4}$ 3.43) across three groups: elite, sub-elite and novice and participated in this study. The elite group comprised 45 athletes with a mean age of 22.19 years (SD $\frac{1}{4}$ 3.10) who had been playing/training in the Australian Football League (AFL) for a minimum of one year (mean time playing at this highest level in the sport $\frac{1}{4}$ 3 years).	We predicted that the elite athletes would perform poorly at slow speeds, as this would de-automate their behaviour, but that performance would improve as the video speed increased. This prediction was also supported by the work of Lorains and MacMahon (2009), where elite athletes improved decision-making accuracy when tested on videos 1.5 times normal speed.	None provided.	Abstract: These results show that athletes perceive moderately speeded video as more game-like. Speeded video is further speculated to have allowed elite athletes to perform more automatically, with a faster processing efficacy, a key characteristic of elite performance. This study suggests the use of speeded video as a potential new research paradigm to explore expertise and a viable method for future training interventions for decision-making. By increasing the speed of the video-based decision-making task, we were able to gain further insight into the processes of expert performance. Elite participants used superior processing efficiency and automaticity to perform more accurately as the video speed increased, while the sub-elite and novice, lacking these characteristics, declined in performance. Using this optimal video speed may allow researchers to gain a better understanding of the mechanism of automaticity and the processing efficiency in elite athletes in decision-making tasks. These findings suggest that from an elite point of view, the video speed of 1.5 may be an optimal video training speed, compared to the more traditional video-based training simulations that are completed in normal speed
55. Differences in Motor Imagery Time When Predicting Task Duration in Alpine Skiers and Equestrian Riders. Louis et al (2012)	Yes	Yes	Two groups of athletes gave informed consent to take part in the experiment, and the University's Research Ethics Committee granted ethical approval. The first sample was composed of 21 skiers (13 men and 8 women) divided in two groups depending on their expertise level. The first group was composed of 12 skilled skiers competing at the national level (8 men, 4 women; M age = 14.5 years, SD = 1.2), and the second group included 9 novice recreational level skiers (5 men, 4 women; M age = 23.9 years, SD = 2.2). The second sample included 16 equestrian riders (4 men, 12 women). As with the skier population, a first group was composed of 8 elite riders competing with a regional license (3 men, 5 women; M age = 34.8 years, SD = 7.8). A second group included 8 novice riders not licensed (1 man, 7 women; M age = 18.4 years, SD = 1.3).	We also expected an effect of expertise level. Due to their schematic knowledge of the performance, we believed expert athletes would be able to imagine times closely related to actual performance times. In contrast, because novice athletes have less schematic knowledge about how to perform a course inspection to achieve their best performance, they should have more difficulty predicting actual performance times.	None provided.	Abstract: These findings provide evidence that the temporal accuracy of an imagery task prediction depends on the performer's expertise level and characteristics of the motor skill. To summarize, the present study provided evidence of the different use of MI in individual expertise level as well as the nature of the task and sporting event requirements.
56. The differential effect of team members' trust on team performance: The mediation role of team cohesion Mach et al (2010)	Yes	Yes	The data for the study were collected from a survey carried out among professional athletes (belonging to 59 different sports clubs) playing in the regular, top professional Spanish leagues (2004–2005 season): basketball (ACB), handball (ASOBAL), roller hockey (OK-Liga), and indoor football (FNFS) ...778 players playing on 66 teams were approached to participate in the study. Of these, 690 professional players on 59 teams participated, resulting in an 89% response rate. The average size of teams was 11.7 members (SD $\frac{1}{4}$ 2:3), the average age of the respondents was 25.5 years (SD $\frac{1}{4}$ 1:6), the average tenure with the organization, 3.6 years	The sports world offers a wide range of examples of teams that work well together and teams that do not (Katz,2001). If we consider the large amount of money and resources invested in this sector, it is not difficult to imagine the great pressure placed on professional sports teams. Players need to perform well from the beginning and maintain a high level of performance until the end of the season. Thus, professional sports teams provide an ideal context to explore the manifestations of group dynamics and their relationship to performance. To analyse trust within organizations that are structured as a team, the context of professional sports provides an excellent opportunity to examine these factors because sports teams have a self-contained nature and clear performance outcomes.	None provided.	Abstract: This study illustrates the dynamic relationship within teams, and, as such, trust among teammates mediates the relationship between trust in the coach as well as team cohesion in determining team performance. Our findings reveal the significance the work environment has for team performance. Environments that foment clarity, reliability, concern for others, and openness, and in which there is a relatively high degree of harmony and cohesion among the players and the other actors have the potential to improve their performance. By contrast, environments in which players do not trust each other, the coach, or top management will likely have poorer results.

			(SD ¼ 1:4), and the average tenure with their coach was 1.8 years (SD ¼ 0:9).			It is also important to note that the use of sports teams as a target group in this study implies some limitations in terms of external validity. Generalizing these findings to other sectors should be done with caution. There are obvious differences between sports teams and other organizational teams in terms of how resources are measured and relationships between members are maintained, though, a full discussion of these issues is beyond the scope of this article.
57. The role of psychological characteristics in facilitating the pathway to elite performance Part 1: Identifying mental skills and behaviours MacNamara et al (2010)	Yes	Yes	Data were collected from separate interviews with female (n = 4) and male (n = 3) world-class athletes and a parent for each participant (n = 7). The ages of the athletes ranged from 21 to 37 years (M = 30.1 years, SD = 5.0 years) and all had competed at the top of their sport for between 4 and 13 years (M = 7.5 years, SD = 2.8 years). At the time of the interview, five of the athletes continued to participate in senior international competitions while two of the athletes had retired from international competition within the preceding two years. Additional demographic and sporting information for all athletes is presented in Table 1 [including major sporting achievements = elite sample].	Considerable research evidence attests to the role of psychological factors as determinants of elite performance. Orlick and Partington (1998), for example, identified psychological “success factors” (e.g., high level of commitment, long and short term goals, imagery, focus, pre- and in-competition plans) that distinguished successful athletes from their less successful counterparts. Despite this almost universal acceptance of psychological factors as characteristic of those who compete at the highest level (Gould et al., 2002; Orlick & Partington, 1998; Williams & Krane, 2001), their possible role in reaching this level is comparatively neglected. The aspiring elite must pass through various stages of development as they progress (e.g., sampling, specialization, investment; Bloom, 1985; Côté, 1999), recognizing that the requirements to achieve (e.g., amounts of deliberate practice; Ericsson & Charness, 1994) change with this progression. Accordingly, the purpose of this two-part investigation was to examine the careers of successful athletes to identify the attributes perceived to have contributed to their development into successful and consistent world-class performers. The first examination was facilitated through retrospective interviews with world-class athletes and their parents, to gain an insight into the factors perceived to have enabled their own success against the challenges they had to overcome.	None provided.	Abstract: Accordingly, we suggest that talent identification and development programs should place greater emphasis on the advancement and application of psychological behaviors at an early stage to optimize both the development and performance of athletes. The similarity between the current results and those characteristics found to facilitate performance at elite levels (Baker & Horton, 2004; Gould et al., 2002;) suggests that psychological factors also play a crucial role in determining the developmental capacity of an individual.
58. What makes an orienteer an expert? A case study of a highly elite orienteer's concerns in the course of competition Macquet et al (2012)	Yes	Yes	The study participant represented “a paradigm case”; his highly elite status gave him prototypical value (see Flyvbjerg, 2006). To elaborate, he had participated in the world orienteering championships for 13 consecutive years, winning gold at the sprint or middle distance six times. Since the present study, he competed at another world championship event, winning gold at the middle distance. Based on this record, it is arguable that he is currently the world's best orienteer, and also one of the best ever.	However, a shortcoming of this research, and research on expertise in sports generally, is that few researchers have conducted investigations of the cognitive activity of expert athletes in relation to specific competitive events. Performers are more likely to provide valid information about their use of cognitive strategies during performance if they are asked to recall thoughts experienced in relation to specific, real performances rather than to report about the cognitive strategies they use in their sport in general (Eccles, 2011). A second limitation of the extant research is that few studies have involved attempts to understand performers' concerns in relation to entire competitive events. Little is known about how elite performers spend their time thinking during such events... Such information would be useful in understanding what makes individuals expert in sports with a strong cognitive (decision-making) component as well as other domains characterized by decision-making under complexity, uncertainty, and time pressure. It would also allow insights into how to develop expertise in these domains. Consequently, this study aims to identify, via postperformance interviews, the concerns of a highly elite orienteer throughout two specific competitive events. The study participant represented “a paradigm case”; his highly elite status gave him prototypical value (see Flyvbjerg,	None Provided.	Abstract: In conclusion, this study provides insight into the cognitive processes underlying expert performance in sports characterized by decision-making under complexity, uncertainty, and time pressure. The performer was shown to utilize during performance a range of knowledge-driven strategies that enhanced the efficiency of task performance and to flexibly switch between strategies and decision-options in the face of presented changes in the task status. The performer was also shown to engage in a range of reflective processes concurrent with performance that augmented the use of these strategies. The continued study of the cognitive activity of expert athletes in domains such as orienteering will extend our understanding of skill acquisition and expert performance in sports with a strong cognitive component as well as in other domains characterized by decision-making under complexity, uncertainty, and time pressure.

				2006)...Thus, to paraphrase Sears (1992, p. 148), the attempt here was to “know one performer well”. In doing so, we hoped to provide within the study of expert sports performance a detailed case study of an exemplar; a product deemed critical to the effectiveness of a scientific discipline (Flyvbjerg, 2006; see also Wolcott, 1995).		
59. Striving for success or addiction? Exercise dependence among elite Australian athletes. McNamara & McCabe (2012)	YES	Yes	Participants were 234 elite athletes (118 males, 116 females) who resided in Australia. Athletes ranged from 18 to 50 years of age (mean 22.55 years) and represented 25 sports (see Table 1). One hundred and fifty-two of the athletes competed internationally, whereas 82 competed at a state level. One hundred and seventy-four of the athletes held athletic scholarships, and 76 had commercial sponsorships. The number of hours spent training and competing ranged between 4 and 48 per week, with an average of 17.25 hours.	There is growing awareness that athletes can develop an unhealthy preoccupation and involvement in too much exercise and training (Hausenblas & Giacobbi, 2004)... There is limited understanding of the factors that contribute to this condition, particularly among elite athletes who may be most at risk of experiencing exercise dependence... The current study was designed to advance our theoretical understanding of this condition and to determine the utility of a biopsychosocial model to explain the development and maintenance of this condition among elite Australian athletes. Studies that have examined the occurrence of exercise dependence... (have) sampled predominantly recreational exercisers, rather than groups of athletes who may be more likely to become exercise dependent, such as elite athletes. There has been limited research on exercise dependence in this population. They present particular problems in determining exercise dependence, since they are required to engage in high levels of exercise as part of their training regime. The current study used a measure of exercise dependence specifically developed for use with elite athletes to categorise them into those at risk or not at risk of exercise dependence.	After obtaining ethics approval, names and contact addresses of elite athletes were obtained from the Australian Institute of Sport, and State Institutes and Academies of Sport in Australia. Names of elite athletes were also obtained from elite sporting teams and competitions within Australia. All participants for whom we obtained names and addresses were approached to take part in the study.	Abstract: These results support the utility of a biopsychosocial model of exercise dependence in understanding the aetiology of exercise dependence among elite athletes In conclusion, our findings demonstrate that a high proportion of elite athletes are at risk of exercise dependence. Factors that were strongly associated with exercise dependence were social support and pressure from coaches and teammates. Elite athletes are already under considerable pressure to perform, and these results suggest that additional pressure from others to train is associated with exercise dependence. Coaches and teammates need to be aware of the dangers of putting undue pressure on elite athletes, provide the opportunity for them to discuss any problems they are experiencing and provide them with the social support necessary to perform at a high level without the dangers of exercise dependence.
60. Spatial ability and motor performance: Assessing mental rotation processes in elite and novice athletes Moreau et al (2011)	Yes	Yes	A total of 98 participants took part in the study... The first group was composed of sixty athletes (M = 22.8 years; range: 18-29) divided as follows: 20 fencers, 20 judokas, and 20 wrestlers. For each sport, half of the athletes were elites (M = 22.3 years, f males and 5 females), which means that at the time of the study they held at least one selection in an international event among the Olympics, World championship or European championship. Thirty-eight road runners made up the second group (M = 23.9 years; range: 19-32). This group included 19 elites who represented their country in an international event (M = 22.5 years, 10 males and 9 females).	We hypothesised that elite athletes whose particular activity involves mental manipulation should display better results in mental rotation tasks than novices or than elite and novice athletes practicing activities that do not require particular spatial abilities. Comparing performances of elite athletes in sports involving rotations in three-dimensional space (combat sports) and of elites practicing a cardiovascular sport that do not specifically involve rotations (running) was meant to ensure that the potential differences are not solely due to fitness outcomes but genuinely related to particular cognitive demands. We expect to observe better motor imagery... and better mental rotation performance... in elite athletes, who have trained for a long time and got better results in competition, than in novices.	None provided.	Abstract: These results help fostering our understanding of the relationship between motor representations, spatial abilities and performance in sports. Elite athletes, practicing daily a combat sport among fencing, judo or wrestling – but not running – showed consistent high performance in the MRT. In itself, this finding is quite interesting because it provides further evidence for a strong tie between motor performance and spatial abilities, such as mental rotation in particular. From the results presented in this paper, we believe that spatial abilities improved by sport practice could be used for different tasks and activities, such as other sports, but also in independent fields, such as academic and professional ones. Following that idea, this trend of work helps raise sport practice as a determining factor to build up general and transferable abilities. Since sport might help developing spatial abilities – traditionally thought to be mainly improved by academic-related material – it could provide interesting ideas to governments and public institutions for sports advertising or for training programmes designs. Indeed, it might be possible to detect potential cognitive weaknesses that could lead to different problems in sport performance, via appropriate testing... Spatial abilities needed in particular areas could be developed through an appropriate practice in sports, or, on the contrary, decisive abilities in sports could be sought elsewhere.
61. Defining and characterising team resilience in elite sport Morgan et al	Yes	Yes	The sample in this study included a total of 31 participants (17 female, 14 male) who ranged in age from 18 to 36 years (M 25.7, SD 5.2). The participants had been competing in their respective teams for between 1 and 12 years (M 4.55, SD 3.28). Participants represented the following sports:	Resilience is recognized as an important psychological phenomenon for understanding the positive development of people who overcome a variety of difficulties during the course of their lives (Masten & O’Dougherty Wright, 2010). Within elite sport, teams frequently experience adversity, and being able to positively adapt to such situations represents a	Following institutional ethical approval, the Performance Directors of each team were contacted by telephone or email and the purpose and	In conclusion, this study developed a definition of team resilience and identified the resilient characteristics of elite sport teams. Team resilience was defined as a dynamic, psychosocial process which protects a group of individuals from the potential negative effect of the stressors they collectively encounter. It comprises of processes whereby team members use their

(2013)			rowing (six female participants), field hockey (five female participants), soccer (six male participants), handball (six female participants), and futsal (eight male participants). The rowing team members had won eight Olympic medals and 10 world titles, and the field hockey team members were ranked in the top five sides in the world with three world championship medals. The soccer team members competed professionally in the English Championship division, the handball team members participated in Olympic and European competition, and the futsal team members competed internationally for their respective country.	significant challenge for athletes and coaches. Indeed, research in sport psychology has revealed that specific stressors are encountered within elite team environments, including the quality of coach/player interactions, poor communication channels, letting teammates down, and negative aspects of organizational culture...Although such research has identified the types of stressors present within team environments, the exploration of how a team's collective resources can be harnessed to positively adapt to adversity has been largely overlooked in the sport psychology literature. Recently, however, team resilience has emerged as an important concept in business and health psychology and researchers have begun to elucidate how groups respond favourably to adverse events	requirements of the investigation were communicated.	individual and collective resources to positively adapt when experiencing adversity. Four general dimensions emerged which characterized team resilience in elite sport: group structure, mastery approaches, social capital, and collective efficacy. These characteristics are a distinct set of resources peculiar to groups which, in line with Horne and Orr's (1998) reflections, suggest that individual resilience does not necessarily guarantee resilience at the group level. Indeed, the results reported here support Luthar's (2006) claim that "resilience rests, fundamentally, on relationships" (p. 780) and show that this is particularly pertinent for teams seeking to excel at the highest levels of sport.
62. Competition stress and emotions in sport performers: The role of further appraisals Neil et al (2011)	Yes	Yes	Performers ranged in age from 19 to 56 years (M \pm 23.67, SD \pm 10.32) and had competed at either district to national level (non-elite) or at major international championships, such as European and World Championships (elite). The elite sample included three females competing in the sports of rowing (participant A), hockey (B), and swimming (C), and three males competing in snooker (participant D), rugby union (E), and mountain bike riding (F). How many though?	None. research has furthered our understanding of performers' experiences during competition. Nevertheless, the interrelationships between the components of the stress process and the meaning performers ascribe to these associations need further consideration (Neil et al., 2007, 2009), as do the emotional responses that such appraisals generate, the orientations of these emotions, and the consequential behaviors. The purpose of this study, therefore, was to illuminate the stress and emotion process in sport performers, with particular insight into the role of further appraisals (i.e., emotional orientation), and the perceived impact that appraisals and emotions have on subsequent performance.	For the purpose of this study follow-up interviews were conducted with the sports performers sampled in the study by Mellalieu et al. (2009).	Abstract: The present findings provide insight into the transaction of athletes with their environment via their appraisals and illuminate the relationship between these initial appraisals, emotions, further appraisals, and subsequent behavior. Through the use of a qualitative approach, we have provided insight into the transaction of athletes with their environment, together with the relationship between emotion, its orientation (i.e., further appraisal), and consequential behavior.
63. Cardiac and respiratory activity and golf putting performance under attentional focus instructions Neumann & Thomas (2011)	Yes	Yes	Elite golfers (10 male, 6 female) were professionals or amateurs who had competed at state or national representative events. The groups did not differ in the ratio of males to females, $c(2)(2)\%15$, $p>.05$, or in mean age, $F(2, 47)\%3.09$, $p>.05$. The experienced group had a significantly higher handicap (M \pm 8.00, SD \pm 7.04) than the elite group (M \pm 0.44, SD \pm 1.71), $t(30)\%4.17$, $p<.001$, but they did not differ in playing experience (experienced: M \pm 11.94 years, SD \pm 7.10; elite: M \pm 10.81 years, SD \pm 4.49) or playing frequency per month (experienced: M \pm 7.88, SD \pm 7.01; elite: M \pm 11.94, SD \pm 7.51), both $t_s<1.58$, $p>.05$.	More research is needed on how performers' level of expertise interacts with their focus of attention (Wulf, 2007).	Participants were recruited from state and national representative squads, local clubs, and the university... Experienced and elite golfers were reimbursed \$15 and novices received course credit for participation.	Abstract: The results show that athletes at different skill levels differ in their performance and focus of attention while performing a motor task. The present research has confirmed recent evidence that participants at various skill levels differ in patterns of cardiac and respiratory activity during golf putting (Neumann & Thomas, 2009). It extends previous work by showing that an explicit attentional focus instruction influences cardiac activity, but does so differently for individuals at different skill levels. The present results encourage the use of cardiovascular measures during a training program in golf... The present results also showed that participants at a lower skill level are especially influenced by attentional focus instructions. They demonstrate how goal setting can be used effectively in training programs, particularly with athletes at lower levels of skill development.
64. Effects of anxiety, a cognitive secondary task, and expertise on gaze behaviour and performance in a far aiming task Nibbeling et al (2012)	YES	Yes	Eleven male, right-handed, experienced dart players (with a mean age of 34.2 years, SD \pm 9.6 and a mean experience of 11 years, SD \pm 5)	one would also expect different effects of anxiety on expert and novice perceptual-motor performance. In general, skills get automated over practice, thereby reducing the attentional resources necessary to perform a certain task (e.g., Brown & Carr, 1989). In other words, novices are expected to allocate much attention to the planning, selection, and control processes concerning task execution, while this is no longer the case for experienced performers whose task execution is highly automatized. As such, novices are likely to be affected more by anxiety as the limit of their attentional resources will sooner be exceeded, due to the extra attention that is consumed by anxiety. As a result, less attention would be left available for task execution, resulting in a decrease in performance	None provided.	Abstract: Anxiety affects efficiency and sometimes performance in far aiming tasks. Changes are accompanied by changes in gaze behavior, particularly the final fixation on the target. All in all, findings provide support for Attentional Control Theory as a suitable framework to explain the effects of anxiety, a cognitive secondary task, and expertise in far aiming tasks. In general, the findings provide support for Attentional Control Theory (ACT) as a suitable framework to explain the effects of anxiety, a cognitive secondary task, and expertise in far aiming tasks.
65. Meta experiences and coping	Yes	Yes	Ten elite level athletes (7 males, 3 females), with a mean competitive sporting experience of 11.0 years (SD \pm 2.9), agreed to take part in this	Attempt to replicate the findings from a previous case study among a larger sample.	The participants were first contacted by e-mail. In this e-mail the general	Abstract: Meta experiences are instrumental in explaining the impact of experiences upon performance and have an important role in determining the selection, implementation and

effectiveness in sport Nieuwenhuys et al (2011)			study.1 As experience is thought to play an important role in athletes' ability to reliably reflect on past performances (Hanin, 2003, 2004; Hanin & Syrjä, 1995a, 1995b) all participating athletes were required to at least compete at an international level. The mean age of the participants was 30.6 years (SD ₁ 10.0). Sports that were included were synchronized swimming, cycling (track and road), track and field (400 and 1500 m), speed skating, triathlon and ultrarunning.	In their study, Nieuwenhuys et al. (2008) showed that all three levels of performance-related experiences (situational experiences, patterns of experiences, and meta experiences) were present in an elite athlete's account of a significantly good and bad competition and that these experiences could be structured along the lines of the Triple-A framework...the current study aimed to replicate the findings of Nieuwenhuys et al. by conducting the same method with a larger group of athletes from different sports, thereby gaining more insight into the role of meta experiences in determining the selection, implementation and eventual effectiveness of coping strategies.	nature of the study was explained and participants were asked if they would be interested to take part. In case of a positive reaction, participants were contacted by phone to provide them with more detailed information; confidentiality and anonymity were assured and an appointment was made for the interview	effectiveness of coping strategies. Based on the results, it can be concluded that the method that was employed to assess athletes' performance-related experiences and use of coping strategies is suitable for usage with athletes from a wide range of (individual) sports and disciplines.
66. <u>Effects of visual control training on the shooting performance of elite female basketball players.</u> Oudejans (2012)	Yes	Yes	In two seasons, a total of twenty one elite female basketball players with a mean age of 18.3 years (SD = 1.3) participated in the study. On average, they had 9.8 years (SD = 2.7) of competition basketball experience. All were members of the National talent program in which players train for 20 hours a week under the leadership of several certified coaches. All participants played in the highest league for women's basketball in The Netherlands and, as a requirement, all players were also in the National selection of their age group (U16, U18,U20, Seniors).	Assumed visual control training would be most effective with elite players. For three-point shots (from further than 6.25, 6.75, or 7.24 m depending on the competition) the best shooters shoot around 50% both in the NBA and the WNBA (nba.com; wnba.com), while the last in the top-50 of three-point shooters (the 50th best shooters in the NBA and WNBA), shoot between 30% and 40%. This implies that even for elite players there is room for improvement, making it worthwhile to find ways to do so. Apart from rote learning to optimize and automatize shooting technique (involving many repetitions on a daily basis) ([1-3], see also [4]), specifically improving visual control seems to hold promise in that regard... Both studies reveal the potential value that specifically designed visual control training can have on the shooting performance of (even) elite basketball players.	None provided.	Abstract: Gradual increases of shooting percentages over training sessions inspired additional confidence in the conclusion that pre-posttest improvements were related to the visual control training. The Plato-goggle system provides a promising tool to be used in sports practice to improve performance. For now, on the basis of the current findings it can be concluded that special visual control training performed on the field with wirelessly controlled LC goggles seems to hold promise, both with regard to the applicability in the actual sports setting and with regard to the potential to improve performance.
67. Training Visual Control in Wheelchair Basketball Shooting Oudejans et al (2012)	Yes	Yes	Ten male expert wheelchair basketball players (M age = 25.5 years, SD = 6.1) volunteered to participate in the study. All were members of the Dutch National team and had an average of 9.4 years (SD = 5.2) of experience in competition wheelchair basketball.	Relatively little training aims at improving players' perceptual skills (Abernethy, 1996), while there is accumulating evidence that perceptual expertise is an important factor in several sports (see Williams & Ward, 2003). A key question is whether it is possible to speed up or optimize perceptual skill development through training. The study by Oudejans et al. (2005) is one of few examples from the constraints-led approach that shows visual control training may enhance performance...Given several limitations of that study, a replication of the findings with different manipulations and task constraints was necessary. Therefore, the aim of the current study was to investigate whether a visual control training program designed specifically for expert wheelchair basketball players could also improve their shooting performance... The effectiveness of the program with this new group would support the applicability of the general principle behind the training program: forcing players to use the most useful information for the task by manipulating (visual) constraints in the training environment	None provided.	Abstract: The findings support the idea that perceptualmotor learning can be enhanced by manipulating relevant constraints in the training environment, even for expert athletes. To conclude, when information is constrained during visual control training, it may facilitate perceptual-motor learning in sports. In the current study, the screen provided a simple tool that could easily be implemented in regular basketball training sessions. Probably, there is considerable scope for innovative and creative implications of visual control training in other sports as well. In general, visual control training may be relatively easy to implement in practice, depending on the sport in question. Using specific visual constraints, athletes could be forced to rely on information that is crucial for task execution...thereby improving performance.
68. Thoughts and attention of athletes under pressure: skill-focus or performance worries? Oudejans et al (2011)	Yes		A total of 70 expert athletes (41 men, 29 women), representing 19 different kinds of sport, returned the completed verbal reports via email and provided written informed consent. Athletes represented nine individual and 10 team sports. About 25% of the athletes competed at the international level while 75% competed at the highest national level. The mean age of the participants was 23.4 years (SD ₁ 3.5). The mean number of years of experience at the highest level of competition was 5.0 years (SD ₁ 3.3).	There is converging evidence that pressure-induced anxiety causes shifts in attention that lead to decrements in performance... With respect to perceptual-motor tasks, self-focus theories claim that with increased anxiety there are shifts in attention to internal matters. These shifts either lead to explicit attention to the sequential steps of how the skill should be executed (explicit monitoring hypothesis)... or perhaps even to conscious control of the sequential steps of how the skill should be executed (conscious processing hypothesis)... In experts such explicit conscious attention to, or even control of, subsequent steps of a skill may interfere with normal task execution hereby affecting performance.	Verbal report questionnaires were sent out to approximately 350 athletes (precise number is not known as the verbal reports were also distributed via coaches).	Abstract: These results are more in line with distraction theories than self-focus theories, suggesting that attention to performance worries rather than to skill execution generally explains choking. Altogether, the findings suggest that next to distracting worries and positive monitoring, competition pressure does not often induce skill-focused attention. Distracting thoughts and worries occur much more often and these are reported to be important for choking. These findings are consistent with recent findings in the literature, particularly those by Gucciardi et al. (2010).

				In the current study we examined to what degree skill-focused attention as well as distracting thoughts and worries spontaneously occur in high-pressure situations in expert athletes from a variety of sports. To that aim we explored thoughts and attention of expert athletes in such settings, without manipulating attention itself.		The results reflect the degree to which different foci of attention seem to occur in general when expert athletes perform under high competitive pressure. The results suggest that the manipulation of skill-focused attention within experimental settings (as adopted by the majority of choking studies), does not appear to replicate the attentional disruption that occurs under ‘‘real life’’ pressure conditions. the current study shows that, generally, pressure induces more distracting thoughts and worries than skill-focused attention, making clear that preventive measures for choking should be directed at reducing worries and enforcing positivementoring.
69. Exploring the retirement from sport decision-making process based on the transtheoretical model Park et al (2012)	Yes	Yes	All participants were either current or former Korean elite-level tennis players. We chose this particular sport so we could examine the Korean sport context from both the semi-professional and professional levels and include athletes from both genders. A total of 12 participants, seven males and five females, took part in one of three focus groups and included, current players (n = 4), retired players (n = 5), and coaches (n = 3). Seven participants were current or former national team members, two were national junior team members, and three were former semi-professional players. The participants' mean age was 31.25 years (SD = 3.49). The current players were planning to retire from their sport within 4 months to 3 years. The retired players' and coaches' mean time after retirement was 6.9 years (SD = 3.85; range = 1-11).... they had to have elite-level competitive experience (intercollegiate, semi-professional, or professional level).	Necessary sample to answer the research question. The current study is the first to examine elite Korean athletes' career transition experiences...The purpose of this study was to extend current knowledge of the athletes' career transition process through employing the transtheoretical model as a theoretical framework. More specifically, the current study aimed to explore Korean elite tennis players' career transitions through focusing on the retirement decision making process, including their cognitive and behavioral changes, and internal and external influences, on their decisions during the final stages of their sport careers and the retirement decision making process.	Purposeful sampling was used for selecting the participants with the aim of selecting information-rich cases (Patton, 2002). A total of 21 potential participants were identified via snowball sampling and were contacted by phone and invited to participate in the study. Initially, 19 agreed, but seven were unable to attend focus groups	Abstract: Findings indicated that the transtheoretical model helped to explain athletes' decisionmaking in retiring from sport and suggested to the need to provide different interventions at different stages. The present study explored the process of athletes' retirement decision-making and provided a new way of understanding the process by using the transtheoretical model (Prochaska & DiClemente, 1984). The results indicated that athletes' decision making proceeded through a series of stages, and that several stages (e.g., pre-contemplation, contemplation, preparation, and action) appeared similar to the stages of change in the transtheoretical model.
70. Subjecting elite athletes to inspiratory breathing load reveals behavioral and neural signatures of optimal performers in extreme environments Paulus et al (2012)	Yes	Yes	Ten adventure racers (6 males, 4 females) were recruited by word of mouth and fulfilled the following criteria: (1) participated in multi-day events on an international level; (2) placed among the top 5 performing teams in at least 3 races; (3) completed international races within the past 5 years; (4) were at least 14 days out from their last race.	Altered cortical and subcortical processing of tasks and external conditions has been proposed as an important mechanism that differentiates elite performers from comparison subjects [3]... Taken together, these results are consistent with the hypothesis that elite performers deploy processing resources that are more focused on specific task demands, and they are better able to respond to external stimuli that perturb internal homeostasis. We recently proposed that maintaining an interoceptive balance by generating body prediction errors in the presence of significant perturbations may be a neural marker of optimal performance [8]. This notion is consistent with findings that elite athletes pay close attention to bodily signals [9] and may be particularly adept in generating anticipatory prediction errors [10]. Adventure racing is a combination of two or more endurance disciplines such as orienteering, navigation, crosscountry running, mountain biking, paddling, climbing, and related rope skills. Individuals participating in adventure racing experience significant physical and psychological stress during these competitions, which sometimes result in both significant injury and in mood-state disruption [13]. In this study we examine elite adventure racers who are non-military elite performers and who are often exposed to extreme environments [14]. We have previously proposed that optimal performance may be related to the ability to effectively minimize the body prediction	Ten adventure racers (6 males, 4 females) were recruited by word of mouth	Abstract: These findings support the hypothesis that elite athletes during an aversive interoceptive condition show better performance and an attenuated insular cortex activation during the aversive experience. Interestingly, differential modulation of the right insular cortex has been found previously in elite military personnel and appears to be emerging as an important brain system for optimal performance in extreme environments. Taken together, this experimental approach not only shows that insular activation differentiates elite athletes (as an example of optimal performers) from comparison subjects, but also shows that these individuals perform better during aversive interoceptive stimulation on a simple continuous performance task. Thus, non-hypercapnic breathing load during functional neuroimaging provides a laboratory approach to study elite performers and identify behavioral and brain processes that are important for optimal performance in extreme environments.

				error [8], which allows individuals to better adjust to environmental perturbations. Since the insula cortex is important in generating body prediction errors [33], then one would hypothesize that elite athletes show attenuated neural processing in the insular cortex of afferent aversive interoceptive stimuli. Support for this hypothesis would provide further evidence that elite performers show a distinct brain signature that enables them to adjust more quickly and appropriately to extreme environments. This approach uses simple laboratory tasks to link neural and cognitive processes that have been found to be important for elite performance. As pointed out by others, this approach may help to explain sporting skill at the highest levels of performance [1].		
71. Relationship between biological markers and psychological states in elite basketball players across a competitive season Robazza et al (2012)	Yes	Yes	Participants were nine male professional basketball players, aged from 23 to 37 years (M age \bar{x} 29.1, SD \bar{s} 5.2), who represented a whole team in a town located in the center of Italy. For many years the team had been among the most prestigious Italian basketball teams playing in the division one (top level) championship. At the time of the research, the team ranked 11th at the end of the championship. The team won 7 of the 12 games considered in the study. Athletes' playing experience ranged from 13 to 27 years (M \bar{x} 19.3, SD \bar{s} 4.8). During a 6-month competitive season, players had been involved in at least one weekly game. Practice sessions took place eight times a week and lasted about 2 h each.	Among other factors, skill level has been found to be a strong mediating variable in symptom interpretation, with elite athletes experiencing intensity symptoms of unpleasant emotions as more facilitative and less debilitating than non-elite performers	Access to the competition site was gained after having explained the research project and the main goals of the study to the head manager, coach, physical trainer, and then to the whole team	Abstract: Findings suggest that elevation of testosterone, cortisol, a-amylase, and chromogranin A in basketball players prior to competition can have a perceived functional effect with respect to the upcoming performance. Taken as a whole, these results suggest that assessing an array of PBS states and biological responses in a holistic perspective has the potential to expand and deepen our knowledge of the individual's psychophysiological experience associated with competition.
72. Developmental activities and the acquisition of superior anticipation and decision making in soccer players Roca et al (2012)	Yes	Yes	A total of 48 skilled, male defensive or defensive midfield soccer players (age 20.7 + 2.4 years; mean + s) participated. Players were recruited from a range of different semi-professional soccer clubs in the United Kingdom.	Assume/predict that elite batters will have better anticipatory skills than recreational players. The ability to anticipate and make decisions is presumed to be particularly important at the elite level in soccer... Most recently, researchers have started to examine how these perceptual-cognitive skills are acquired by expert athletes (e.g., Ford, Low, McRobert, & Williams, 2010a). In this study, we extend work in this area by examining whether elite soccer players categorised as either high- or low-performing based on their performance on an interactive test film of anticipation and decision making can be differentiated based on the amount and/or type of activity undertaken during their development... There is a need to integrate and examine the antecedents of other components of expert performance such as decision making in order to provide a more complete illustration of perceptual-cognitive expertise in sports such as soccer (Williams & Ward, 2007). The amount and type of activities that elite soccer players engage in may provide some indication of the antecedents of expert performance... In this paper, we examine whether soccer players with different levels of perceptual-cognitive expertise can be differentiated based on their engagement in various types and amounts of activity during their development.	None provided.	In summary, we categorised skilled players into high- or low-performing groups based on their scores on a test of anticipation and decision making. We examined whether these groups could be differentiated in regard to the amount and type of activities in which they had participated during development. The average hours per year in soccer-specific play activity during childhood was the strongest predictor of performance on the perceptual-cognitive test and differentiated the skill groups. We hypothesise that soccer-specific play activity during childhood provides the conditions for players to engage in anticipation and decision making leading to lasting adaptations and improvements in these abilities. Soccer-specific practice activity during adolescence was also a contributing factor to the variance in anticipation and decision making scores across participants, supporting previous work in cricket (Ford et al., 2010a; Weissensteiner et al., 2008). No differences across groups were reported for number of other sports engaged in during development or some of the key milestones achieved.
73. Pre-performance psychological states and performance in an elite climbing competition. Sanchez et al (2010)	Yes	Yes	A sample of 19 male (24.6 \pm 3.95 years of age) elite climbers who qualified for the finals of the Belgian Climbing Championship participated in the study. Levels of current baseline ability were extremely high, ranging from 7b1 to 8b on the French Rating Scale of Difficulty (F-RSD, where 7a or above is considered to be expert or elite; Watts et al., 2003; ASc,i et al., 2007). Following previous research current ability was gathered	Previous studies have not examined psychological variables in relation to actual competitive climbing performance, neither examined elite climbers' actual performance nor climbing performance in a naturalistic setting.	Before the competition day, approval to carry out the study was obtained from both the Belgian Climbing Federation and the organizers of the competition. On the day of the competition, before the arrival of the climbers, umpires were	Abstract: The psychological states preceding elite climbing competition appeared to be an important factor in determining success, even when differences in baseline ability were taken into account. Findings showed that successful climbers reported higher pre-performance levels of SA and climbed the most difficult part of the route more slowly than their unsuccessful counterparts. The psychological states preceding elite climbing competition appeared to be an important factor in determining success, even

			as a measure of climbing expertise because an individual's climbing standard can vary throughout a single year (Smyth & Waller, 1998).		informed of the testing procedures. Permission was given to have free access to all restricted areas, such as the climbers' isolation room and the umpires' sector, in order to distribute questionnaires and gather official output performances, respectively. At the registration desk, after the competitors registered, they were individually approached and invited to take part in a study investigating climbing competition. The investigators ensured that the participants understood the overall purpose of the study without providing specific details. Informed consent from those who agreed to participate was acquired.	when differences in baseline ability were taken into account. We report the first ecologically valid study of preperformance psychological states and performance in an elite climbing competition. Findings suggest that in elite non-traditional sport competition pre-competitive SA, which correlated with positive affect, was beneficial to performance... The psychological states preceding elite climbing competition appear to be an important factor in determining success, even when differences in baseline ability are taken into account.
74. Effects of achievement goals on self-regulation of eating attitudes among elite female athletes Scoffier et al (2012)	Yes	Yes	Forty-four nationally ranked competitive figure skaters were recruited. The average age was 15.52 years (SDage=2.43) and all had been skating in competition for at least six years.	These athletes were recruited because of their particular vulnerability to the development of disordered eating attitudes (Sundgot-Borgen, 1994) and their competitive experience. Their vulnerability was due to the strong emphasis on physical appearance in esthetic sports: figure skaters are expected to conform to a sport-specific, ideal body shape. Judges promote an ideal of thinness and many skaters believe they need to reach this ideal to be attractive and successful (Sherman & Thompson, 2009). Adolescent girls are especially at risk of developing disordered eating attitudes (Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004; Polivy, Herman, Mills, & Wheeler, 2003), as are young athletes in esthetic sports like gymnastics and figure skating	None provided.	Abstract: This experimental study confirms the findings of previous correlational works and shows that achievement goals contribute to the causal processes of self-regulation of eating attitudes. These Findings might help to prevent eating disorders in female athletes by providing guidance for the development of adapted motivational strategies These results within the 2 x 2 framework complete earlier studies showing that performance goals are associated with maladaptive achievement patterns with regard to eating attitudes...More generally, these findings (i.e., PAp related to a low self-regulation of eating attitudes) are consistent with studies indicating that transgressive behaviors are encouraged in situations in which winning is everything...They also underline the interest of taking into account both the self-reported and behavioral aspects of self-regulation of eating attitudes... the results of these two studies expand our understanding of how achievement goals influence the self-regulation of eating attitudes in sports. They can perhaps guide the motivational strategies developed by esthetic sports coaches, and may be useful for the mental preparation and health maintenance of at-risk athletes.
75. Adaptive styles in elite collegiate athletes: The role of activation and self-regulation. Steiner et al (2010)	Yes	Yes	Participants were 461 Stanford University varsity athletes and 61 age- and gender-matched controls not participating in varsity sports.	Therefore, to succeed as an athlete, we would expect that individuals are capable of rapid and effective control of activation, particularly emotional activation. While elite athletes have mastered the physical skills required to compete at a high level, they must also develop the ability to manage mental and psychological processes occurring on and off the field (Brassington, 2004).	Data were collected for this study in two recruitment phases; the first has been described elsewhere (Steiner et al., 2003). The second round of recruitment was initiated to gather information on teams that were under-represented in the initial recruitment wave, specifically football	Abstract: Data can be interpreted in at least two ways: (1) athletes are better at dealing with pressure and therefore report lower levels of distress; or (2) athletes report lower distress because they utilize high levels of repressive defensiveness and denial of distress. To our knowledge this is the first study to report comparisons of activation and regulation among elite students, using them to further define athletes and non-athletes. The array of variables that significantly differed in elite athletes was mostly in line with our hypotheses and expectations. Specifically, athletes report less negative emotional activation in comparison to non-athletes.

					<p>and basketball. Players completed all the instruments in private and received one unit of academic credit in undergraduate research.</p> <p>Steiner et al 2003: Student athletes were solicited for the survey upon completion of their preseason physical examination at the athletic department. Students who expressed interest were given consent and survey forms. Participants were asked to place completed surveys in a locked collection box in the athletic department. After this initial effort, the survey was distributed to different athletic teams. Researchers described the questionnaire and distributed them to interested athletes. Athletes who received a survey and did not return it were prompted with a phone call. The final step in data collection was specifically to target football players for inclusion in the sample because they were underrepresented in the initial phase of data collection. To do this, football players were offered course credit for their participation</p>	
76. Influence of Retirement on Body Satisfaction and Weight Control Behaviors: Perceptions of Elite Rhythmic Gymnasts. Stirling et al (2012)	Yes	Yes	Eight retired elite female rhythmic gymnasts who competed previously at the international level participated in the study. Participants ranged from 18 to 24 years of age ($M = 19.88$, $SD = 2.64$). Eight different clubs were represented. The number of years spent in sport ranged from 10 to 14 years ($M = 11.88$, $SD = 1.81$) and the years since retirement ranged from 1 to 6 years ($M = 2.75$, $SD = 1.58$).	<p>Transition out of elite sport has been recognized as a stressful period for many athletes... Although athletes from every sport may face retirement difficulties, it is proposed that female gymnasts, the athletes of interest in this study, may encounter unique challenges due to their high investment in sport during adolescence, a period of identity formation, and the physical changes experienced upon exit from sport.</p> <p>The population of female gymnasts has been studied previously with respect to retirement, body satisfaction, eating and weight control practices...with most of the participants being artistic gymnasts. Another form of gymnastics, rhythmic gymnastics, has received scant attention in the literature.</p>	<p>Following approval from the university's research ethics board, the names of retired gymnasts were acquired from the relevant sport organizations. A snowball sampling technique was used because the pool of desired participants was so small (Berg, 2007). Athletes were contacted by e-mail and asked if they were interested in participating in this study.</p>	<p>In conclusion, this study confirms previous research that rhythmic gymnasts experience body dissatisfaction and weight-control difficulties upon retirement (Warriner & Lavallee, 2008). This study contributes to the literature by highlighting behaviors of over-indulgence and feelings of guilt around eating upon retirement and highlights specific weight-control behaviors used by rhythmic gymnasts during sport retirement. It also challenges previous research by suggesting that staying in the sport after retirement through coaching may not ease the transition if the athlete's well-being was negatively affected by experiences in sport. Future prospective research designs would assist in answering many of the existing questions in this area of research.</p>
77. Specialisation pathways among elite Danish	Yes	Yes	The 17 athletes (10 women and seven men; aged 18 to 40, mean age = 25 years) were all elite athletes supported by Team Denmark. The term 'elite' refers to athletes who represent the	The characteristics of the optimal pathway to elite sport performance is not a novel research issue but one that researchers have tried to shed light on for decades...Studies of optimal specialisation pathways	None provided.	Abstract: Discussion centres on how the study informs the notion of age cut-off points, sampling, practice and transitions in relation to DMSP and how this is linked to the cultural context.

athletes: a look at the development model of sport participation from a cultural perspective Storm et al (2012)			national teams and compete at the international level. We selected the athletes on the basis of age, gender, sport and level of achievement with a review to reflecting Danish sports culture that is athletes in the most popular (in terms of participant numbers) and most successful (in terms of international medals) sports in Denmark. It should be noted that 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.	inspire practitioners and thus hold considerable power in terms of how sporting environments organise their youth activities [Elite athletes integral to understanding the topic, i.e., specialisation pathways to elite performance]		The Developmental Model of Sport Participation outlines two specialization pathways towards elite performance. The present study suggests that specialization pathways are unique trajectories embedded in a cultural context. Detaching the specific elements of the DMSP allowed us to draw a more nuanced picture of athletes' specialization pathways comprising: (1) early specialization, (2) late investment and playful training, (3) late entry into main sport, and (4) sampling in playful training. The notion of age cut-off points, sampling, practice and transitions in relation to DMSP and how this is linked to the cultural context hold the potential to nuance our discussion of the optimal pathway to sport expertise.
78. Exploring adversity and the potential for growth among elite female athletes Tamminen et al (2013)	Yes	Yes	Although there is no one definition of the term 'elite' (Polman, 2012), athletes were considered elite if they had competed internationally within their respective sport (i.e., had been selected to represent Canada at international competitions)...Five elite female athletes between the ages of 18-23 from a western Canadian city participated in the study.	Elite athletes often have to deal with a range of different types of negative experiences in order to perform at high levels of competition. Researchers have detailed various aspects of negative experiences in elite sport (e.g., Gould, Jackson, & Finch, 1993; Udry, Gould, Bridges, & Beck, 1997) however little research has explored the ways in which adversity may (or may not) contribute to growth among elite athletes.... Elite athletes represent a unique population for studying growth following adversity. Generally speaking, elite athletes identify more strongly with an athletic identity than recreational athletes (Lamont-Mills & Christensen, 2006). Maintaining a strong athletic identity may enable elite athletes to perform at high levels within their sport (Stephan & Brewer, 2007), however adversity reported by elite athletes may represent threats to their competence, identity, and sense of self-confidence (Reid, 2012). Since adversity concerns fundamental disruptions to individuals' identities and self-schemas, it would be beneficial to understand how elite athletes experience adversity (i.e., challenges to their identity and self-schemas) and growth	university coaches were contacted to inform their athletes about the study. Coaches distributed information to their athletes who then contacted the researchers to participate in the study.	Abstract: Athletes' experiences of adversity may have initiated a process of questioning their identities and searching for meaning in their experiences. Findings highlighted the complexity associated with social support and athletes' growth following adversity. Growth following adversity appears to be a valuable area of research among elite athletes. Findings highlighted the complexity of meanings athletes associated with adversity and social support, and they perceived growth which reflected changes to their identities as they sought for and found meaning through their experiences of adversity. This study extends the literature by exploring ways in which athletes perceived growth, which may contribute to a broader perspective of athletes' adjustment following adversity.
79. Effects of synchronous music on treadmill running among elite triathletes. Terry et al (2012)	Include	Yes	Participants were six male and five female elite triathletes, aged 19.5±2.3 years (mean±SD), with V̇O ₂ peak scores ranging from 58.6 to 72.6mLkg ⁻¹ min ⁻¹ .	The present study was the first to examine effects of synchronous music with high-level athletes. A group of triathletes from the Queensland Academy of Sport (QAS) was tested during treadmill running, using a range of indices under conditions of self-selected motivational music, music of the same tempo that was neutral in motivation terms, and a no music control.	None provided.	Abstract: Although neutral music did not produce the same level of psychological benefits as motivational music, it proved equally beneficial in terms of time-toexhaustion and oxygen consumption. In functional terms, the motivational qualities of music may be less important than the prominence of its beat and the degree to which participants are able to synchronise their movements to its tempo. Music provided ergogenic, psychological and physiological benefits in a laboratory study and its judicious use during triathlon training should be considered. Results of the present study are encouraging because they serve to highlight the potential importance of music in aiding the running experience and performance of elite athletes, a population that was previously understudied in this context. Music provided ergogenic, psychological and physiological benefits during intense aerobic work and these benefits are probably interlinked (e.g., more positive mood and lower RPE leads to greater endurance). There is considerable scope for the further investigation of ergogenic and psychological effects of music in other endurance sports (e.g., swimming, cycling and rowing) and in repetitive training activities (e.g., circuit training/ resistance training). Researchers should consider the neurophysiological mechanisms by which music produces such effects.
80. Defining and contextualising robust sport-	Yes	Yes	Congruent with previous sport psychology research (e.g., Jones et al., 2002), elite performers were defined as those who had	The inclusion criteria related to the use of elite performers. Specifically, elite performers were suggested to possess a greater awareness of robust sport-confidence and its	Thirty-five elite athletes matching the selection criteria were contacted to	Jones et al. reported that elite athletes experienced a strong and intense belief in two types of confidence: the achievement of competition goals, and athletes' abilities in relation to being

confidence Thomas et al (2011)			received international honors and represented their country at a major event (e.g., European or World Cup, Olympic Games)...Two male and two female individual sport performers, ranging in age between 25 and 39 years old (M = 33.5, SD = 6.19), who had competed at an elite level for between eight and 20 years (M = 13, SD = 5.63), participated in the focus group. The sports represented were judo (n = 2) and triathlon (n = 2)... Eight male and eight female individual sport performers, ranging from 21 to 56 years old (M = 35.44, SD = 10.48) who had competed at an elite level for between two and 35 years (M = 11.19, SD = 9.48) participated in individual interviews...participants in phase two were independent of those used in phase one, and incorporated athletes from archery (n = 3), athletics (n = 4), bowls (n = 2), cycling (n = 3), judo (n = 1), triathlon (n = 2), and swimming (n = 1).	characteristics than their non-elite counterparts due to their career experiences as athletes competing at the top level of their sport (cf. Bandura, 1997; Vealey & Chase, 2008).	take part in the study. However, in accordance with the considerations of the research framework adopted in this study (e.g., theoretical data saturation), 20 elite athletes were used in the two-phase approach.	superior to their opponent. While the present findings support that of Jones et al. they also reveal that robust sport-confidence is a strong and intense belief across multiple types, rather than just two types, of sport-confidence. These findings concur with previous qualitative literature that has demonstrated elite athletes' levels of confidence are susceptible to periods of instability and can fluctuate over time The present study provided a systematic examination of robust sport-confidence. In summary, the definition and characteristics revealed that robust sport-confidence was a set of enduring and strongly held positive beliefs. The results also supported the multidimensional conceptualization of sport-confidence through the emergence of several types of sport-confidence.
81. Time perception is enhanced by task duration knowledge: Evidence from experienced swimmers. Tobin, S., & Grondin, S. (2012)	Yes	Yes	A group of 28 swimmers (18 male, 10 female) from the Laval University Varsity Swim Team were recruited. They ranged from strong provincial level to international level and were 18 to 23 years of age. A group of 26 elite swimmers (18 male, 8 female) from the Laval University Varsity Swim Team participated. Their expertise ranged from strong provincial to international level. They were 18 to 23 years old, and 19 of them had taken part in the first experiment. A group of 16 Laval varsity swimmers (12 male, 4 female) from 18 to 24 years of age participated in this experiment. They also ranged from strong provincial to international level. Six of them had participated in one of either Experiment 1 or 2.	In the present experiment, we assumed that tasks involving intensive training would produce very high task duration knowledge. Over the years, elite swimmers such as the ones who participated in the experiment have trained to a level that could never be reproduced for experimental purposes in a laboratory. For example, a swimmer who has competed for 10 years (and trained around 20 h per week) will have completed about 750,000 pool lengths, with about 12,000,000 arm strokes, and will thus have accumulated thousands of temporal representations of the distance to be covered.	A group of 28 swimmers (18 male, 10 female) from the Laval University Varsity Swim Team were recruited.	Abstract: These three converging experiments suggest that task duration knowledge is strongly involved in time perception. The first goal of this set of experiments was to assess the influence of task duration knowledge on perceived duration. In that regard, the three experiments produced a coherent set of findings showing the influence of task duration knowledge on different tasks (time estimation and production) and durations (from 36 s to around 90 s). These converging conclusions strongly support the influence of task duration knowledge in timing. The present series of experiments has produced converging conclusions about the role of task duration knowledge on time perception when a participant is informed at the beginning of a task that estimating the duration of that task is required. This series of three experiments consistently showed that task duration knowledge increases time performance, up to an impressive level, in a wide array of timing tasks. First, Experiment 1 led to a hypothesis as to how task duration knowledge may help time perception: by providing a range of possible durations for each task that reduces the risk of error when having to judge time. Furthermore, Experiment 2 showed an interaction between attention and task duration knowledge: The secondary task only interfered when swimmers could not rely on their task duration knowledge. This finding is crucial, as it suggests the presence of a distinct knowledge based mechanism involved in time perception. Finally, the third experiment showed that the physical execution of the learned task was not mandatory for recording enhanced temporal performance. Not only does this finding strengthen the claims of the two previous experiments, it also suggests an innovative approach for supporting time perception. Indeed, visualisation of a well-known task or activity may act as a temporal performance enhancer in other, unfamiliar timing situations
82. The role of volleyball expertise in motor simulation	Yes	Yes	Athletes. Twenty-one elite volleyball players (mean age 26.2± 4.9) were recruited from the Regional Professional League. They trained three times per week for 2 h each and had been playing volleyball on average for 10.7± 3.2	In the present study, we explored how expert volleyball players, fans and novices decide whether the sentences they read refer (or not) to a possible action...Experts should be able to implicitly simulate feasible actions presented as positive contexts only, with longer reaction times for the negative	Twenty-one elite volleyball players (mean age 26.2±4.9) were recruited from the	Abstract: These results suggest that the implicit triggering of motor representations is modulated by the context and it is tuned to people's motor repertoire, even when actions are described linguistically

Tomasino et al (2012)			years.	context (Tomasino et al., 2010). By contrast, no simulation should occur for semantically correct but impossible actions.	Regional Professional League.	In summary, presenting action-related verbs as negative or positive contexts seems to be a promising approach to investigate the interaction between language and motor systems...Our results, by showing the context-dependent effect, strengthen the idea of an indirect connection between the motor and language systems via sensorimotor representations and motor simulation...and that motor representations are only engaged under specific conditions, with effects that are variable and context-dependent.
83. The effects of conscious processing on golf putting proficiency and kinematics. Toner & Moran (2011)	Yes	Yes	Study 1: A total of 14 male expert golfers participated. Their mean age and handicap were 27.14 years (s ^{1/4} 11.42) and 2.6 (s ^{1/4} 1.9) respectively. The participants' handicaps ranged from 0 to 6. Study 2: A total of 18 male expert golfers participated. Their mean age and handicap were 29.2 years (s ^{1/4} 11.46) and 3.56 (s ^{1/4} 1.88) respectively. The participants' handicaps ranged from 0 to 6.	When describing their peak performances, many elite athletes indicate that they devote little or no conscious attention to the mechanics of their movement (Jackson, Martin, & Eklund, 2008). In contrast, when expert athletes suffer performance anxiety (e.g. as happens in "choking")...they may increase the amount of conscious attention that they devote to their movements, thereby interrupting automated skills and impairing subsequent performance (Jackson & Beilock, 2008). According to Beilock and Carr's (2001) explicit monitoring hypothesis, consciously attending to step-by-step skilled behaviour impairs expert performance significantly as high-level execution is thought to be governed by proceduralized knowledge that is run without conscious attention to task components. According to Masters' (1992) theory of "reinvestment" (see recent review by Masters & Maxwell 2008), performance breakdown is likely to occur when expert performers "reinvest" or manipulate conscious rule-based knowledge in an effort to control their movements during motor output. A limitation of the studies by Mullen and Hardy (2000) and Gray (2004) is that they examined only how conscious monitoring (i.e. attending to a specific aspect of technique) influences automated movement. They did not investigate the influence of either technical adjustments or conscious modifications on performance proficiency or on kinematic aspects of experts' movements. Therefore, to fill this gap in the research literature, in the current study we employed motion analysis technology to examine the influence of excessive conscious control (technical adjustments) on the putting performance of a sample of expert golfers.	None provided.	Overall, the present results suggest that different types of conscious processing seem to have contrasting influences upon expert performance and movement. More precisely, our findings indicate that for golfers, conscious control (in the form of technical adjustments) may disrupt the timing and consistency of automated movement – despite having no influence on overall putting proficiency. In contrast, the act of conscious monitoring may disrupt performance proficiency but have no influence on automated movement.
84. <u>Increased Cortical Thickness in Sports Experts: A Comparison of Diving Players with the Controls.</u> Wei et al (2011)	Yes	Yes	In this study, (the Athlete Group) comprised 12 professional diving players with top-level skills (6 females and 6 males). Age (year): 14.58 (1.68) Average practice time per day (hr): 6.54 (0.38) Duration of practice (year): 10.12 (0.86) Age of commencement (year): 5.33 (0.98)	Additionally, studies on humans revealed that the brain structures of experts in playing basketball, playing golf or practicing judo are different from that of the general people [8,19,20,21,22,23]. However, the results obtained by these studies lack consistency. The neuroanatomical changes following extensive training are not fully understood. Although there is no direct evidence to infer that the change in the parahippocampal gyrus is related to a certain motor or mental task, it is reasonable to propose that it might be associated with expertise, especially the spatial information processing in view of the role of this mental processing in diving.	None provided.	Abstract: Moreover, a significant positive correlation between the mean cortical thickness of the right parahippocampal gyrus and the training experience was detected, which might indicate the effect of extensive training on diving players' brain structure. Our study revealed that the sports experts' brains are quite different from those of the general population, and the different brain region is associated with extensive training.
85. The cognitive representation of a throwing technique in judo experts –	Yes	Yes	We tested 8 judo experts (6 male, mean age 27.1 years, ranging from 21 to 32 years). Most all of the experts are current/or were previous members of the German National Judo Team and performed at the highest national and international level. Five experts participated at	Athletic expertise is signified by distinct memory structures, in which so-called basic action concepts (BACs) provide the representational basis for the voluntary control of complex actions... Bläsing et al. (2009)...were able to demonstrate differences in	None provided.	Abstract: The SDA-M method can be used as a diagnostic tool to measure individual skill representations, which helps to improve performance-related instructions and to optimize technical training routines in high-performance sports. The SDA-M method can be used as a diagnostic tool in sport

<p>technological ways for individual skill diagnostics in high-performance sports</p> <p>Weigelt et al (2011)</p>			<p>world championships and/or the Olympic Games and six are currently members of different 1st division judo teams. They had an average of 18.0 years of experience in the sport.</p>	<p>the cognitive skill representations between novices, advanced and expert dancers for two complex ballet skills. A noticeable detail of their study was that advanced dancers showed some initial clustering, but were more variable in their structures than experts, while novices did not show any reliable representations of the two ballet skills. From this observation, it can be inferred that becoming an expert in a particular sport may also rely upon the development of cognitive skill representations.</p> <p>While this has been already done in the field of clinical rehabilitation (Braun et al., 2007, 2008), there are no such examples within the domain of sport psychology. On one hand, this would provide for the opportunity to gain knowledge about an athlete's specific cognitive skill representation (i.e. his/her individual skill profile) and on the other hand, it would give coaches a tool to offer performance-related instructions and feedback, with the goal to optimize technical training beyond the use of traditional methods from biomechanics (i.e. analysis of movement kinematics), which most often rely on the expertise of judges and/or reference data for a particular movement. To this end, the present study investigated the cognitive skill representations of high-level judo experts to provide meaningful examples of how such practical knowledge can be gained.</p>		<p>psychology, complementing previous methods in expertise research (e.g., verbal self-report, subjective ratings, or sorting methods). This experimental approach provides objective psychometric data, which can be further analyzed with advanced statistical procedures. Hence, measuring the cognitive representations of complex skills with SDA-M offers an effective tool to gain further knowledge about an athlete's individual skill representation. Most importantly, such skill diagnostics can inform coaches (and athletes) about specific movement problems that are reflected in the athlete's long-term memory structures. This provides the opportunity to improve performance-related instructions and gives coaches an additional diagnostic tool to optimize technical training routines. The SDA-M method goes beyond the use of traditional assessments in biomechanics, such as measuring kinematic parameters of human motion (e.g., Zatsiorsky, 1998), by unrevealing the cognitive representation structures of complex motor behavior in long-term memory (see Rosenbaum, 2010). The present study, and in particular the use of the SDA-M method as a diagnostic tool to measure individual skill representations in sport, complements recent studies in clinical rehabilitation (Braun et al., 2007, 2008) and extends current conceptions and methodologies on expertise research in applied sport science</p>
<p>86. <u>Distinguishing psychological characteristics of expert cricket batsmen.</u></p> <p>Weissensteiner et al (2012)</p>	YES	Yes	<p>Twenty one adult male cricket batsmen participated in this experiment. The highly skilled batsmen, all of whom had attained senior state and/or national representation, were recruited from the Cricket Australia Centre of Excellence and Queensland representative squads and ranged in age from 20.3 to 26.1 years ($n=11$, $M=22.5\pm 2.0$ years) with an average of 13.3 years playing experience ($SD=2.8$)</p>	<p>Based upon existing knowledge, it was hypothesised that the skills and attributes required for elite performance would be multi-dimensional with the highly skilled batsmen characterised by a higher level of adaptive perfectionism, optimism, mental toughness and coping ability than their lesser skilled counterparts.</p>	None provided.	<p>Abstract: If mental toughness can be reliably predicted at an earlier age, it may be an attribute worthy of inclusion in future talent identification and development programs</p> <p>Collectively, these findings suggest that the psychological attributes required for exceptional sporting performance are task and/or sport-specific with the mental toughness attribute and its dimensions specific to self-belief, motivation, commitment and perseverance being central to elite batting performance.</p> <p>The current investigation features a number of theoretical advances compared to previous studies in this area. A common approach of past investigators has been to make a priori assumptions as to what psychological characteristics and skills underpin elite sport performance without having this search guided in a systematic way by the knowledge of domain experts.</p>
<p>87. Something to Shout About: A Simple, Quick Performance Enhancement Technique Improved Strength in Both Experts and Novices.</p> <p>Welch & Tschampl (2012).</p>	Yes	Yes	<p>Fifty participants were recruited for the study (M age = 22.2, $SD=3.3$ years; M body mass = 77.0, $SD=15.4$ kg; M height = 174.2, $SD=10.0$ cm)... The other half of the sample (17 male, 8 female) formed the expert group with at least 24 months of martial arts experience (M experience=89.0, $SD=49.9$ months) and the rank of black belt.</p>	<p>The majority of the literature has focused on the effect of strength or force performance enhancement strategies in either novices or experts, but rarely with both (Tod et al., 2003), and some discrepancies can be found in the studies that included participants with a range of experience levels.</p> <p>Strategies have been shown to improve performance during simple dynamic strength tasks using a free-choice psych-up technique...but evidence that prescribed techniques can improve performance is inconsistent and not as widely studied. There has been some suggestion that novices may not benefit at all from prescribed strategies, because of lack of experience, while experts may not benefit from the prescription of specific techniques due to entrenched preferences... The kiap, due to its simplicity, is easily learned and therefore has the potential to be used by both novice and experts to improve performance.</p> <p>The purpose of this study was, therefore, to examine the effect of kiaping, as a performance enhancement technique, on strength during a handgrip exercise and to determine whether the level of expertise of the participants influenced its effectiveness.... It was hypothesized that the kiap would</p>	<p>Participants were recruited from martial arts clubs at a large Midwestern university, the surrounding area, and the State Black Belt Association.</p>	<p>In conclusion, there has been conflicting literature on whether strength performance enhancement strategies (e.g., psyching up techniques) improve performance or not, whether prescribed techniques are effective, and whether there is a difference between expert and novice capabilities. The present study examined the effect of a novel performance enhancement strategy (a simple technique taken from martial arts known as the kiap) on handgrip strength in both novice and expert martial artists. Analysis of the data found significantly higher handgrip strength with the kiap when compared to no kiap for both novices and experts. Furthermore, there was no significant difference in the effectiveness of the technique between novices and experts, so substantial experience with the kiap does not appear to result in further increases in strength. These results indicate that the kiap can be learned easily and can be effectively used to increase strength after only a short period of training... it is important to note that the kiap, a breathing technique resulting in a loud expulsion of air, may be considered similar to the grunting that occurs in tennis, power lifting, and other sports in which explosive movements are necessary. Therefore, these results may have important implications for athletes, coaches, and officials...who may be under the assumption that such</p>

				significantly increase the strength output of both novice and experts, compared to no kiap, and that experts would have a significantly greater increase in strength output than novices in the kiap condition due to their experience with the technique.		strategies are used by athletes solely as a distraction technique.
88. Predictive validity of a three-dimensional model of performance anxiety in the context of taekwon-do Wen-Nuan et al (2011)	Yes	Yes	The participants of the study were all university-based taekwon-do athletes at the National Intercollegiate Athletic Games, which is the most important and largest-scale annual competition for all university sports in Taiwan. There were two levels of sports ability involved in this taekwon-do competition. Only those competing at a highly skilled level (i.e., who majored in taekwon-do and trained daily for several hours) were included in the current study. The sample consisted of 99 participants (nmen - 54; «women - 45) from the sports majoring departments of seven universities in Taiwan. Thirty-seven participants were international competitors, and 15 had won medals in world-class competitions. The mean age was 20.51 years (SD = 1.72), which was comparable across sexes (men - 20.61, SD - 1.88; women = 20.38, SD = 1.51).	As skill level may exert a significant effect in the context of anxiety and performance (Jones et al., 1993), this subgroup of a very high standard was targeted because such athletes are more aware of their stress states and have a better capacity to assess their own performance than would performers at a less-skilled level.	All participants and team coaches were contacted and briefed on the objective of the study by the first author two weeks before the competition, and were briefed again on the procedure one day before their competition...The taekwon-do competition lasted for four days with matches from Round 1 to Round 5 if performers continued to win. Round 1 was specifically targeted so that data could be collected from all participants... All questionnaires were anonymous and administered by a small group of trained research assistants, who were familiar with taekwon-do sports and therefore had a better capacity for building good rapport with participants under the stressful circumstances.	In sum, the current study provides initial support for two of the three predictions within the three-dimensional framework of performance anxiety in the context of elite taekwon-do performance... the adaptive potential of anxiety stressed in the present anxiety model appears central in the dynamics of the anxiety-performance relationship. Undoubtedly, further tests are necessary across other sport contexts and cultures.
89. VISUAL SKILLS AND PLAYING POSITIONS OF OLYMPIC FIELD HOCKEY PLAYERS Wimshurst et al (2012)	Yes	Yes	Twenty-one male international field hockey players (M age=25.4, SD=5 yr.) participated in a sports vision-training programme. All were members of the British Olympic team.	Regardless of the physical strength, speed, or technical skill of an individual, an ability to quickly and correctly process visual information can be the difference between elite and non-elite performers... Previous studies have identified marked differences between elite and non-elite sport performers in a variety of visual skills... As with the differences highlighted between elite and non-elite athletes, it could be argued that different positions in ball games might demand different visual skills. However, despite the need for understanding visual skills in hockey, not only for talent identification but also in performance, few researchers have tried to define visual skills of elite players and understand any differences by playing position.	None provided.	Abstract: This suggests the possibility of improving visual skills even in an elite population. To conclude, prior to any visual training, there were no differences in visual skills across players of different positions within an elite field hockey team... These preliminary data suggest the possibility of improving visual skills even in an elite population, although it is unknown whether this will affect their playing performance.
90. The role of visual perception in action anticipation in basketball athletes Wu et al (2013)	Yes	Yes	Fifteen basketball players (mean age 19.6 ± 1.3 years, age range 18–21 years) and 15 age-matched novices (mean age, 19.3 ± 1.3 years, age range 17–21 years) participated in the study. All participants were right-handed (Bryden, 1977) males. The basketball players were national second-level athletes, recruited from the basketball team of Shanghai University of Sport; they were trained 7 ± 1.7 h per week for	Behavioral studies show that elite athletes exhibit high execution accuracy and excellent performance in anticipation of rapid and complex motor tasks. In particular, elite athletes are able to make decisions within limited time when the game is in progress (Allard et al., 1980; Starkes and Allard, 1983; Starkes, 1987; Bard and Goulet, 1994; Williams et al., 1999). Action anticipation is highly relevant to motor skills. Experts display better action anticipation compared to novices in a variety of	The basketball players were national second-level athletes, recruited from the basketball team of Shanghai University of Sport;	Abstract: We conclude that the processes for action anticipation in elite athletes and novices are different and this difference is caused by different visual perceptions between them. Using a temporal occlusion paradigm, the present study found better behavior in athletes compared to novices in different stages of anticipation. This greater ability in visual perception in athletes is correlated with higher functional activities in multiple brain areas including IPL and IFG. We

			3–10 years (mean duration, 6.4 ± 1.9 years).	<p>sports... The difference between elite athletes and novices in action anticipation may be resulted from better visual perception in elite athletes compared to novices. Visual perception is an active process of locating and extracting visual information from the environment and integrating them with other sensory inputs. In addition, various cognitive factors including past experience, motivation and development are involved in incorporating all the integrated information in visual perception. Previous studies revealed that the methods elite athletes and novices used to extract visual information for anticipation are different (Abernethy, 1990a,b, 1991; Williams and Davids, 1998; Abernethy et al., 2005) and that elite athletes might extract kinematic information of observed domain-specific actions to predict their future course more efficiently than novices (Ward and Williams, 2003; Overney et al., 2008).... However, it is still not clear how visual perception is involved in the anticipation of a motor task and what the underlying neural elements are as it is applied to the functional activity in the related brain areas.</p> <p>We hypothesized that the processes for action anticipation of an experience-related motor task in elite athletes and novices are different and that this difference is caused by different visual perception between two groups. Our hypothesis may also predict that IPL and IFG (related to mirror neuron systems) will show more functional activity in the athletes than novices during this process of action anticipation.</p>		conclude that the processes for action anticipation in elite athletes and novices are different and this difference is caused by different visual perceptions between them.
91. Examination of practice activities related to the acquisition of elite performance in Canadian middle distance running Young & Salmela (2010)	Yes	Yes	<p>Forty-eight male Canadian middle distance track athletes voluntarily participated in the study. Each participant was currently training for and competing in either the 800, 1500, or 3000 m events... The National (Nat) group was comprised of 10 athletes (M age = 25.4 ± 3.8 yrs) who had run faster than the Olympic Trials Qualifying Standard, meaning that they were competing at the national-level within Canada. The Provincial (Prov) group was comprised of 24 athletes (M age = 21.6 ± 3.2 yrs) who had a personal best record of performance that was within 5% of the aforementioned criteria, meaning that they were competing at the provincial/state level. The Club group consisted of 14 athletes (M age = 20.2 ± 3.0 yrs) who had achieved a performance time which was within 15% of the Olympic Trials qualifying standard, meaning that they were competing at a regional/local level</p>	<p>Assume that elite participants will have accumulated sufficient deliberate practice to yield differences that can be examined – expertise study.</p> <p>The purpose of the present study was to contrast results for an exclusive set of DP activities with those resulting from more encompassing accumulated measures that related to all training activities or total distance (kilometers) run. To our knowledge, this was the first attempt to use a sport-specific DP activity set, which had been defined <i>a priori</i> by the same sample of runners (Young & Salmela, 2002), in between-group analyses. In order to validate aspects of the DP framework, it was hypothesized that, across the runners' careers and at any point in a career, group differences would be associated with significant differences in accumulated DP activities equally or to a greater degree than differences in accumulated practice in all activities or total distance run. Finally, the present investigation examined performance group differences with respect to accumulations in specific individual training activities in middle distance running. Due to the fact that the analyses pertaining to these specific individual training activities were somewhat exploratory in nature, no hypotheses were advanced regarding this latter line of inquiry.</p>	Participants were recruited in-person at track and field meets and by electronic mail.	In conclusion, the present findings did not offer evidence for the validity of an exclusive metric for DP activities for middle distance runners, nor for cumulative practice in all track activities or cumulative kms run, across the first seven yrs of a career... Findings suggest that acquired performance advantages in Canadian middle distance running might be related to more elite groups' efforts to accumulate training in specific individual activities.

Note: We initially aimed to review how these studies recruited/gained access to their athletes, but decided not to include this data.