ABSTRACT

MAPPING THE WORLD OF COACHING SCIENCE: A CITATION NETWORK ANALYSIS

The field of coaching science has experienced rapid expansion in recent years, yet it has also been criticized for its lack of conceptual clarity (Cushion, 2007; Gilbert & Trudel, 2004; Lyle, 2002). The purpose of the present study was to identify and describe key publications and influential researchers in coaching science using citation network analysis. The study sample included 141 English-language peer-reviewed coaching science research articles in 2007 and 2008. A citation network analysis was conducted on the references of the 141 articles (3,891 references) to identify the key publications influencing coaching science. These key publications were then coded for type (e.g., conceptual, empirical) and topic (e.g., efficacy, coach development). The structure of the field was revealed through the creation of a co-authorship network. Finally, a Researcher Influence Factor (RIF) was computed, taking into consideration the number of citations received by a researcher's publications as well as his/her social capital. The citation network showed that of the top 10 publications, six were conceptual papers or books while four were empirical publications. Research on coach development was the most prominent topic among the key publications. Analysis of the most influential researchers revealed, amongst other findings, the dominance of the USA, Canada, and the UK in coaching research. Therefore, coaching science is highly influenced by a small set of key publications and researchers.

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MAPPING THE WORLD OF COACHING SCIENCE:
A CITATION NETWORK ANALYSIS

by
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Chapter 1

INTRODUCTION

Over the past century, sport has assumed an increasingly significant role in society around the world. Sport is now a global phenomenon with billions of spectators and participants involved in a dizzying array of sports annually. For example, more than 10,000 athletes from 205 different countries participated in the last Olympic Games in Beijing (IOC, 2008). In addition, 4.7 billion viewers –or about 70% of the world population- tuned in to watch these athletes compete in more than 300 different events, reaching an all-time high in television audience for the Olympics (The Nielsen Company, 2008). With this increased significance of sport, the role of the sport coach has become extremely important. As a result, there is a global push to professionalize sport coaching. This is evident in the recent creation of organizations like the International Council for Coach Education (www.icce.ws), and regional movements like SportscoachUK (www.sportscoachuk.org) and the National Council for Accreditation of Coach Education in the United States (www.aahperd.org).

This increased interest in sports coaching has resulted in an unprecedented interest in coaching literature as more and more people aspire to become a coach or deepen their understanding of the coaching process. For example, a recent search on Amazon.com for ‘sports coaching’ retrieved 8,493 books on the topic, with nearly 600 published in 2009 alone (www.amazon.com, 9-22-09). This, of course, does not even include the vast array of multi-media products and research articles written about sports

coaching. Research on sports coaching is growing at an astounding pace. From 1970 to 2001, an average of 30 articles on coaching were published annually (Gilbert & Trudel, 2004). An updated analysis of coaching research articles from 2004 to 2008 shows that more than 70 articles on coaching are now published annually (Rangeon, Gilbert, Trudel, & Côté, 2009). This explosion of scientific coaching literature is supported by the creation of new coaching journals as well as sport psychology journals devoting special issues to coaching science. For example, *The Sport Psychologist* published a special issue on coach education in 2006 and at least three new coaching science journals have been created since 2006 including the *International Journal of Sports Science & Coaching*, the *International Journal of Coaching Science*, and the *Journal of Coaching Education*. Given the ever-growing body of literature on coaching, it becomes more and more challenging for practitioners and researchers to get a grasp of the big picture of coaching science, and apprehend the interconnectedness of literature. To reach their ultimate goal of coaching effectiveness, practitioners and researchers alike would benefit from a single resource that provides them with an overview of the most important literature on sport coaching.

Purpose Statement

The purpose of the proposed study will be to conduct a research synthesis of coaching science using citation network analysis. More precisely, the objective will be to identify key publications, conceptual frameworks, and authors in coaching science.

Research Questions

- What are the seminal publications that are shaping current coaching science?
- What conceptual frameworks have most influenced current coaching science?
- What are the seminal studies that are shaping current coaching science?
- Who are the most influential researchers in coaching science?

Significance

Literature reviews are a crucial element for the development of any field. To set research agendas and conduct relevant studies, researchers in coaching and teaching rely on literature reviews published periodically in scientific books and articles (Horn, 2008; Silverman & Skonie, 1997; Singer, Murphey, & Tennant, 1993; Wittrock, 1986). The amount of research published on coaching has increased steadily since the 1970s (Figure 1), and has been literally booming in 2007 and 2008 (Rangeon, et al., 2009). The last comprehensive review of coaching science was completed in 2002 (Gilbert, 2002; Gilbert & Trudel, 2004). An up-to-date systematic review of coaching science thus has a number of practical implications both for designing future coaching research and to provide practitioners with a better understanding of past and current coaching science literature.

On the one hand, results of the present study will help coaching researchers situate their work in the broader network of coaching science. It will also help them realize the importance and implications of citation practices on a larger scale. The present study uncovers the most prominent research topics, thus revealing the major questions coaching researchers have

Figure 1. Publication rate of coaching science articles from 1972 to 2008 (Rangeon, Gilbert, Trudel, & Côté, 2009)

been trying to answer in the past decades. Researchers will then be able to set research agendas based on a deep understanding of the current state of research in the field.

On the other hand, coaching practitioners will also greatly benefit from an up-to-date analysis of coaching science. Coaches often lack access and time to delve into scientific articles. As a result, they often limit their sources of knowledge and self-improvement to non-scientific sources such as personal experience, websites, videos, and various coaching books (Dieffenbach, 2008; Gilbert & Trudel, 2001; Jones, Armour, & Potrac, 2003; Lemyre, Trudel, & Durand-Bush, 2007; Salmela, 1995; Wright, Trudel, & Culver, 2007).

However, these sources of knowledge mostly reflect personal experiences and opinions, rather than scientifically proven findings. The cost and time required to read scientific articles makes this choice in knowledge sources fully understandable. But a piece of research revealing the most influential publications could be of great use to such a demanding population. In addition, similar issues can be faced by coach educators. In fact, this particular population needs to stay current on the recent advances in the field to adapt their curriculum appropriately. In order to design the most effective courses and programs, coach educators also need to comprehend the full scope of coaching literature and to understand how influential publications are linked to one another.

To conclude, coaching researchers, as well as coaches themselves, and coach educators can greatly benefit from reviews of coaching science to keep track of the trends and advances in the field. The present study is particularly relevant because it uncovers the structure and

interconnectedness of key publications in the field and the researchers who produce this literature.

Delimitations

The sample used in the present study is delimited to peer-reviewed English-language research articles published in 2007 and 2008, and containing the word “coach” in the title in reference to sport coaches.

Limitations

Because the sample was delimited to articles written in English-language only, a cultural bias needs to be acknowledged. Coaching science articles published in languages other than English were not taken into consideration. A recent study of coaching science research written in French shows that only 48 articles on sport coaching have been published in the last 20 years (Cloes, Lenzen, & Trudel, 2009). Furthermore, a recent review of coaching science around the world shows that the USA, and by extension articles written in English, clearly dominate published research on sports coaching (Côté, Trudel, & Gilbert, 2009). Even though some coaching science articles in other languages exist, it is minimal in comparison to the amount of coaching science published in English, and therefore would not significantly impact the results of the present study.

Definition of Terms

Analytical research: “Type of research that involves in-depth study and evaluation of available information in an attempt to explain complex phenomena.” (Thomas, Nelson, & Silverman, 2005)

Citation network analysis: Technique consisting of revealing the links between articles in an effort to “map” the literature in a given field. The underlying concepts of this technique have been described by Garfield (1964):

Citations are the formal, explicit linkages between papers that have particular points in common. A citation index is built around these linkages. It lists publications that have been cited and identifies the sources of the citation. Anyone conducting a literature search can find from one to dozens of additional papers on a subject, just by knowing one that has been cited. And every paper that is found provides a list of new citations with which to continue the research. (p. 1)

Citation path analysis: Usually conducted as part of a citation network analysis, the goal of citation path analysis –or main path analysis- is to reveal the development of literature over time (Moore, Shiell, Hawe, & Haines, 2005).

Coaching science: Coaching science refers to research on the coaching, learning, and instructional processes as directed by sport coaches. Coaching science includes research on coach behaviors, cognitions, personal characteristics, and occupational issues (Gilbert & Trudel, 2004).

Content analysis: “A generic name for a variety of means of textual analysis that involve comparing, contrasting, and categorizing a corpus of data” (Schwandt, 1997), or “Any of several research techniques used to describe and systematically analyze the content of written, spoken, or pictorial communication-such as books, newspapers, television programs, or interview transcripts” (Vogt, 1999)

Literature review: “Information analysis and synthesis, focusing on findings and not simply bibliographic citations, summarizing the substance of

a literature and drawing conclusions from it” (ERIC Processing Manual, 1982).

Meta-analysis: “The statistical analysis of a collection of analysis results from individual studies for the purpose of integrating the findings” (Cooper & Hedges, 1994).

Research synthesis: “A research synthesis is not simply a summary of the related literature; it is a logical type of research that leads to valid conclusions, hypothesis, evaluations, and the revision and proposal of theory” (Thomas et al., 2005).

Chapter 2

LITERATURE REVIEW

Research syntheses are a crucial element for the advancement of any scientific field. The importance of such pieces of research was highlighted more than a century ago (Rayleigh, 1885). As an “analysis, evaluation, and integration of the published literature” (Thomas et al., 2005), research syntheses have to be more than a mere summary of existing research. In this regard, methodological procedures need to be described in great detail to ensure accurate and credible conclusions (Thomas et al., 2005).

Meta-analysis and content analysis are the two most commonly used types of research syntheses. Citation network analysis is another type of research synthesis that is gaining increased attention by researchers.

In the first section of this chapter, common methods for analyzing bodies of literature will be described. In the second section, examples of how these analytic techniques have been used to make sense of coaching science will be provided.

Description of Analytic Techniques

Meta-analysis

Even though meta-analysis has been used for more than a century by researchers (Simpson & Pearson, 1904), practitioners and policy makers started to recognize its importance in the late 1980s (Chalmers et al., 2002). Relying on statistical analysis of quantitative data, meta-analysis is often employed when rigorous quantitative synthesis is called for (Glass, 1976).

Researchers compile the results of several studies measuring the same phenomena to draw larger conclusions based on analytical comparison (Thomas et al., 2005). Indeed, when numerous studies have been conducted on a particular topic, the flow of information and results can become confusing. Researchers then compile and analyze the results of many individual studies to identify trends and patterns in the results on a larger scale. Meta-analysis is a systematic quantification methodology relying on effect size. Several steps are recommended when conducting a meta-analysis (Getsie, Langer, & Glass, 1985):

1. Define the research area and qualifications for inclusion of studies.
2. Conduct a complete literature search to find all possible members of the defined population of studies, whether published or unpublished.
3. Identify, describe, and code the characteristics and variables of the collected studies.
4. Statistically analyze the data and compute standardized effect sizes for relevant dependant variables.
5. Group and compare the obtained effect sizes according to the research characteristics identified in Step 3.

Examples of such reviews abound in the sport psychology literature. Studies on topics such as cohesion and athletic performance (Carron, Colman, Wheeler, & Stevens, 2002), anxiety and performance (Kleine, 1990), affect and achievement goals (Ntoumanis & Biddle, 1999), the effect of mental practice on motor skills and performance (Feltz & Landers, 2007), increasing physical activity (Dishman & Buckworth, 2007), and group versus individual approaches to exercise (Burke, Carron, Eys, Ntoumanis, & Estabrooks, 2006)

have been the subjects of meta-analysis. But no research synthesis of coaching science using meta-analysis can be found in the existing literature. This can partly be explained by the diversity in the instruments and the relative importance of qualitative methods used to study coaches.

Content Analysis

Very popular in the social sciences, content analysis draws valid and reliable conclusions from analyzing a number of existing texts (Krippendorff, 2004). More often quantitative than qualitative, this type of research synthesis relies on systematic and objective methodologies (Holsti, 1969). According to Krippendorff (2004), “[m]uch content analysis research is motivated by the search for techniques to infer from symbolic data what would be either too costly, no longer possible, or too obtrusive by the use of other techniques” (p. 51). In other words, content analysis consists of systematically classifying elements of texts into meaning units based on explicit rules of coding (Krippendorff, 2004).

Six questions must be addressed in every content analysis (Krippendorff, 2004):

1. Which data are analyzed?
2. How are they defined?
3. What is the population from which they are drawn?
4. What is the context relative to which the data are analyzed?
5. What are the boundaries of the analysis?
6. What is the target of the inferences?

Youth sport (Gould, 1982; Weiss & Bredemeier, 1983; Weiss & Raedeke, 2004) and talent development in sport (Alfermann & Stambulova,

2007; Durand-Bush & Salmela, 2001) have been subjects of such research syntheses in the past two decades. Content analysis has also been used previously used in coaching science (Gilbert, 2002; Gilbert & Trudel, 2004).

Citation Network Analysis

Based on graph theory, citation network analysis originates in the 1960s, when Garfield presented the idea of citation index (Garfield, 1964). By indexing and counting citations between articles, researchers uncover the structure and interconnectedness of a given scientific field (Barabási & Bonabeau, 2003; Moore et al., 2005). Publications (called nodes) and the links between them compose a social network that can take two forms. On the one hand, nodes can be connected through a random network as a uniform road grid would be (see Figure 2; Barabási & Bonabeau, 2003). On the other hand, social networks can take the form of a scale-free network (see Figure 3). This type of network is best represented by an airline flight system, in which bigger airports (called hubs) are linked to many smaller airports (Barabási & Bonabeau, 2003). Many links are thus converging toward the same hubs. Citation networks of scientific articles have been shown to take the form of scale-free networks (Barabási & Bonabeau, 2003). Such analyses have been conducted in various fields such as mathematics, physics, biology, engineering, technology, and more recently sport psychology (Bruner, Erickson, Wilson, & Côté, 2010; Delwiche, 2003; Edwards, 1999; Moore et al., 2005).

For a citation network to be a random network, each publication would have to cite approximately the same number of publications, without any hubs appearing. This would be proof of a highly disorganized field of study

Figure 2. Random network (Barabási & Bonobeu, 2003)

Figure 3. Scale-free network (Barabási & Bonobeu, 2003)

where no prominent texts tend to inspire numbers of subsequent studies. Citation networks done so far on research articles have taken the form of a scale-free network in which some central “hubs” (highly cited articles) are connected to many other articles through citation. Subgroups, or “clusters” of articles can also be identified through citation network analysis. This clustering highlights researchers’ citation behaviors and how they tend to cite each other within fields of study (deNooy, Mrvar, & Batagelj, 2005). Prominent scholars, texts, and approaches appear through the network structure (deNooy et al., 2005; Moore et al., 2005). Rather than focusing on both directions of citations at one point in time, main path analysis reveals texts that are most often cited in other papers over time. Therefore, it focuses on the flow of knowledge and allows researchers to identify the roots of a particular area of research (deNooy et al., 2005). Connectivity of texts through citations highlights the main stream of literature that influences current knowledge (Hummon & Dereian, 1989).

Bruner, Côté, Erickson, and Wilson (2001) conducted a citation network analysis (Figure 4) of seven athlete development models in sport (Abbott & Collins, 2004; Bailey & Morley, 2006; Côté, 1999; Durand-Bush & Salmela, 2002; Morgan & Giacobbi, 2006; Stambulova, 1994; Wylleman & Lavallee, 2004). The citation analysis revealed two distinct bodies of research related to athlete development. This study was complemented by a citation path analysis to identify the crucial articles that played major roles in shaping current understanding of athlete development models (Bruner, Erickson, McFadden, & Côté, 2009).

Figure 4. Athlete development citation network diagram (Bruner et al., 2010)

To conclude, meta-analysis, content analysis and citation network analysis are three types of research syntheses that have been used in various fields including coaching and related fields. While meta-analysis relies on numbers and content analysis relies on words, citation network analysis relies on links between texts in the form of citation practices. This method has been proven very useful to reveal the interconnectedness of literature and highlight the development of a field of study over time (Barabási & Bonabeau, 2003; Moore et al., 2005). The existing research syntheses of coaching science have mostly used content analysis and will be described in the next section of the chapter.

Examples of Literature Syntheses in Coaching Science

Although many elements of coaching science have been subjected to comprehensive literature reviews, such as coaching effectiveness (Côté & Gilbert, 2009; Horn, 2008), coaching behaviors (Kahan, 1999; Trudel & Gilbert, 1995), and coaching models (Chelladurai, 2007; Lyle, 2002), only recently have comprehensive reviews of coaching science as a whole been conducted. In this section of the chapter, a brief overview of literature reviews on coaching science in general is first provided, and then examples of reviews on specific elements of coaching science are provided.

Research Syntheses of Coaching Science

Reviewing coaching science as a whole is a laborious task that very few researchers have attempted. First of its kind, an analysis of coaching science research published from 1970 to 2001 was completed by Gilbert and Trudel, with the help of several graduate students from California State University,

Fresno (Gilbert, 2002; Gilbert & Trudel, 2004). Using a four-phase design, this study involved (1) searching for English language research on coaching, (2) obtaining copies of each article, (3) testing the validity of the article list through an expert panel, and (4) analyzing the database compiled. A total of 610 articles were thus coded in regard to their focus, method, participants, context, and sport. Results revealed the prominence of studies on coaching behaviors and use of quantitative methodologies. However, the distinct popularity of quantitative methodologies such as questionnaires/scales and systematic observations seems to be decreasing along the years to the profit of qualitative methodologies (e.g., interviews, qualitative observations/field notes, documents). Another distinctive trend was the dominance of studies conducted with coaches of team sports and in the school based context.

In addition, analysis of the yearly publication rate highlighted the growth of this area of research. In the 1970s, less than five coaching science articles were published each year. The yearly publication rate kept increasing to reach 30 publications per year in the 1990s. A recent analysis of the updated coaching science database revealed that this publication rate is now clearly exceeded. Indeed, more than 70 coaching science articles were published in 2007 and 2008 (Rangeon et al., 2009). This increased interest for coaching science is also observable through conference proceedings. A whole symposium was devoted to a review of coaching science around the world at the 12th ISSP World Congress (Côté et al., 2009). Five presentations provided a world-wide analysis of coaching science and practice in different continents: Oceania, Europe, North America, South America, and Asia. During each presentation, topics such as publication outlets, research funding, certification standards, and dominant lines of research were explored for that

continent. This global symposium allowed researchers to compare coaching science activity in different parts of the world, and revealed the dominance of English speaking countries in the production of scientific articles (Rangeon et al., 2009). However, language barriers were one of the challenges identified during the symposium, particularly in Asia (Koh, 2009) and South America (Santos & Salmela, 2009). An active group of researchers from Oceania are benefiting from the competitive Commonwealth government funding agencies such as the Australian Research Council and SPARC (NZ) for conducting research on coaches (Mallett, 2009). This symposium provided an opportunity for coaching science researchers from across the world to share ideas and ultimately raise the profile of coaching science (Côté et al., 2009).

Therefore, reviews of coaching science as a whole are scarce but bring interesting new findings when conducted. Such endeavors provide researchers and practitioners with pieces of research they can use to grasp a better understanding of the field. Nonetheless, few researchers attempt such laborious tasks and many prefer to review components of coaching science.

Research Syntheses on Components of Coaching Science

Research syntheses of coaching effectiveness. Being every coach's ultimate goal, coaching effectiveness has been the subject of attention of many researchers. But this concept has been defined in many different ways, which makes comparisons between studies rather difficult. Fifteen years ago, an article titled "Coach Effectiveness" was published in the second issue of the *Sport Science Review*, an issue devoted to coaching science (Dodge & Hastie, 1993). This review of literature focused on articles published between

1988 and 1992, and therefore ignores seminal pieces of research published in the late 1970's and early 1980's (Tharp & Gallimore, 1976). In this review, five approaches to analyzing coach effectiveness are described: leadership style and athlete/coach perceptual congruence, self-analysis and reflection, effective application of systematic observation instruments, informant survey and content analysis, and situation-specific analysis. This division of the coach effectiveness literature into five areas shows the already diverging views of the same concept.

Effective coaching has more recently been defined as:

That which results in either successful performance outcomes (measured either in terms of win-loss percentages, individual player development, or success at the national or international level) or positive psychological responses on the part of the athletes (e.g., high perceived ability, high self-esteem, intrinsic motivational orientation, or high levels of sport enjoyment and satisfaction). (Horn, 2008)

Despite this definition, Horn focused her review of literature on how coaches' behavior influences athletes' psychosocial development, leaving successful performance outcomes for someone else to review. As evidenced in this review of literature, the leadership style, behaviors, and feedback patterns of coaches have a great influence on athletes' outcomes. In addition, the importance of the coaching context is highlighted and prevents further generalization of research findings in particular contexts. Additional research in various contexts is thus advocated to grow the knowledge base of coaching science and deepen our understanding of effective coaching (Horn, 2008).

The two main outcomes of coach effectiveness, namely successful performance outcomes and positive psychological responses, have since been

more deeply described by a recently published conceptual paper on coaching effectiveness and expertise (Côté & Gilbert, 2009). Three components of coaching effectiveness are reviewed (coaches' knowledge, athletes' outcomes, and coaching contexts), leading to an integrative definition of coaching effectiveness as "The consistent application of integrated professional, interpersonal, and intrapersonal knowledge to improve athletes' competence, confidence, connection, and character in specific coaching contexts" (Côté & Gilbert, 2009). The first component of coaching effectiveness, coaches' knowledge is sub-divided into three types of knowledge: coaches' professional knowledge, coaches' interpersonal knowledge, and coaches' intrapersonal knowledge. The second component, athletes' outcomes, refers to the 4 Cs: competence, confidence, connection, and character. Through application of their knowledge, coaches should therefore aim at developing athletes' 4 Cs in line with the sport context within which they are coaching. The third component, coaching context, typically involves four different types of contexts: participation coach for children, participation coach for adolescents and adults, performance coach for young adolescents, and performance coach for older adolescents and adults. Two additional contexts could also be considered despite their propensity for leading to dropout: performance coach for children and performance coach for professional adults. Thus, coaching effectiveness now appears as a complex but clearly defined concept, encompassing ideas from various fields such as coaching, teaching, positive psychology, and athletes' development literature (Côté & Gilbert, 2009).

Research syntheses of coaching behaviors. In their analysis of coaching science, Gilbert and Trudel found that more than two thirds of the studies on

coaching focus on behaviors (Gilbert & Trudel, 2004). This study was limited to peer-reviewed research articles, but research has shown that numerous studies on coaching behaviors can be found in other types of sources (Trudel & Gilbert, 1995). In fact, out of 111 documents on coaching behaviors, only 28 of them were research articles (Trudel & Gilbert, 1995). Master's theses and doctoral dissertations were the two biggest sources of studies on coaching behaviors (respectively $n=36$ and $n=32$). Typically, results from several theses were then grouped and presented in the form of congress proceedings ($n=15$). This early analysis of studies on coaching behaviors therefore advises researchers to expand their sources of knowledge to theses, dissertations, and conference proceedings rather than limiting themselves to research articles (Trudel & Gilbert, 1995).

As Trudel and Gilbert (1995) focused on sources for communicating research on coaching behaviors, Kahan (1999) reviewed popular instruments for studying coaching behaviors. Systematic observations of coaching behaviors were made popular by Tharp and Gallimore's study of John Wooden, legendary basketball coach at UCLA (Tharp & Gallimore, 1976). Many research using systematic observation instruments flourished in the next twenty years. To categorize and analyze this important body of literature on coaching behaviors, Kahan (1999) compiled the results of 56 studies using either the Arizona State University Observation Instrument (ASUOI) or the Coaching Behavior Assessment System (CBAS). Results showed that instruction and monitoring were overall the two most occurring types of behaviors. Kahan concludes by advocating more diversity in theoretical frameworks and methodologies.

Research syntheses of coaching models. Highlighting again the general trend to analyze coaching behaviors, Lyle (2002) and Chelladurai (2007) reviewed coaching models centered on behaviors.

After warning the reader about the many challenges attached to modeling the coaching process, Lyle (2002) reviewed four existing coaching models (Côté, Salmela, Trudel, Baria, & Russell, 1995b; Fairs, 1987; Franks, Goodman, & Miller, 1983; Sherman, Crassini, Maschette, & Sands, 1997). Two types of models are distinguished. On the one hand, models ‘for’ coaching stem from a set of assumptions that have not been tested and that are often idealistic. Not grounded in empirical data, the key factors model (Franks, et al., 1983) and the objectives model (Fairs, 1987) are qualified as models ‘for’ the coaching process. On the other hand, models ‘of’ coaching stem from empirical evidence and are constructed using a ‘case-building’ type of approach. Based on empirical data, the ‘mental model’ of coaching (Côté et al., 1995b) qualifies as a model ‘of’ the coaching process.

Lyle (2002) critically examined each one of the models (Sherman et al., 1997). Advancing that “there are few (if any) good models of the sports coaching process and certainly none that have achieved consensual agreement or application” (p. 81), one might question Lyle’s decision to disregard highly popular models. Indeed, it would have been very interesting to read Lyle’s views on the popular multidimensional and mediational models of leadership (Chelladurai & Saleh, 1978; Smoll & Smith, 1989).

Although not reviewed by Lyle (2002), these two models were the subjects of scrutiny of a more recent chapter on *Leadership in Sports* (Chelladurai, 2007). Chelladurai (2007) reviewed and compared two of the most popular coaching models: the mediational model (Smoll & Smith, 1989)

and the multidimensional model of leadership (Chelladurai, 1978). Following a detailed description of each model's components, their respective instruments were in turn evaluated. The Coaching Behavior Assessment System (Smith, Smoll, & Hunt, 1977) and the subsequent Coaching Feedback Questionnaire (Amorose & Horn, 2000) and Coaching Behavior Questionnaire (Kenow & Williams, 1992) are thus carefully reviewed. In the same way, the description of Chelladurai's multidimensional model (Chelladurai, 1993; Chelladurai & Saleh, 1978) is followed by an evaluation of the Leadership Scale for Sport (Chelladurai, 1993) and its revised version (Zhang, Jensen, & Mann, 1997). Chelladurai also quickly reviewed a more recent coaching model: Horn's model of coaching effectiveness (2002). Tinted by the author's partiality to his own line of research, more empirical evidence is advocated to prove the relevance, efficacy, and utility of Horn's model (2002).

Summary

In conclusion, research syntheses of coaching science have first shown that the field is steadily growing, as evidenced by the increasing yearly publication rate (Côté & Gilbert, 2009; Gilbert, 2002; Gilbert & Trudel, 2004). Second, coaching behaviors have ignited great interest from researchers. In addition to being the most important focus category (Gilbert, 2002; Gilbert & Trudel, 2004), coaching behaviors have also been the subject of research syntheses (Kahan, 1999; Trudel & Gilbert, 1995) and the central point of coaching models (Chelladurai, 2007; Horn, 2008; Lyle, 2002).

Even though the research syntheses previously described all contribute to a better understanding of coaching science, no analysis has yet revealed

the roots of this field. To uncover the origins of coaching science, citation path analysis is particularly relevant. Indeed, this method systematically analyzes “the incremental development of knowledge over time and the sequence of texts that constitute the foundation of our present knowledge” (Bruner et al., 2009).

After the recent increase in publication rate and comprehensive content analyses of coaching science (Côté & Gilbert, 2009; Côté et al., 2009; Gilbert & Trudel, 2001, 2004; Horn, 2008), knowing where coaching science takes its roots seems like a healthy step to help researchers and practitioners grasp a better understanding of the field. Having already contributed to the advancement of scientific fields by mapping out their typology (Hummon & Dereian, 1989; Moore et al., 2005), citation network analysis constitutes a helpful and promising way to analyze research.

Chapter 3

METHOD

Even though citation network analysis is based on existing publications, a criterion had to be defined to collect data in the form of citation practices. The present study was therefore considered a primary analysis of data. Figure 5 gives an overview of the methodology.

Figure 5. Overview of the methodology

Data Sample

Text selection for citation network analysis was conducted in two phases. Phase 1 involved searching for English-language peer-reviewed research articles containing the word “coach” in the title published between 2007 and 2008 using multiple databases. References were searched through all the databases available via the EBSCO interface at California State University, Fresno (30+ databases including SPORTDiscus, ERIC, PsycARTICLES, PsycINFO, Academic Search Premier, CINAHL etc.) The same search was then performed on Web of Science, online academic database referencing over 10,000 scientific journals (Knowledge, 2008). Since some new or smaller journals are not referenced yet in online databases, their table of contents were searched via their own website (e.g., Journal of Issues in Intercollegiate Athletics). The full-text of each article, except one that was impossible to obtain, was downloaded either from the online database or requested through interlibrary loan. All references and their full-text were compiled in a coaching science database using the Endnote bibliographic software (www.endnote.com).

Phase 2 added publications cited in the reference list of articles retrieved in phase 1 of the data collection procedure. The final sample analyzed in the study was therefore not limited to research articles but also included books, chapters from books, non-research publications, etc. References from the original sample of research articles, as well as the references in the coaching literature retrieved from a review of these research articles, were compiled in a spreadsheet using Microsoft Excel.

Extracts from the master list created in Microsoft Excel are shown in Tables 1 and 2.

Table 1. Example of Rows from the Original Sample

Endnote ID#	CA ID#	Authors	Year	Title	Cites
2816	1	Abraham, Collins, Martindale	2006	The coaching schematic: validation through expert coach consensus	77, 78, 79, 274 - 321
2934	2	Ahlberg, Mallett, Tinning	2008	Developing autonomy supportive coaching behaviors: An action research approach to coach development	283, 295, 299, 306, 321- 354
2583	3	Amorose	2007	Autonomy-supportive coaching and self-determined motivation in high school and college athletes: A test of self-determination theory	97, 340, 345, 346, 352, 353, 355- 390
2931	4	Andrew, Kent	2007	The impact of perceived leadership behaviors on satisfaction, commitment, and motivation: An expansion of the Multidimensional Model of Leadership	238, 329, 358, 376, 391- 478

Table 2. Example of Added Texts and Collection of Citation Network Data

Endnote ID#	CA ID#	Authors	Year	Title	Book	Cited by #
NA	328	deCharms (1968)			Personal causation	2
NA	329	Deci (1975)			Intrinsic motivation	2, 4
NA	330	Deci, Eghari, Patrick, Leone (1994)		Facilitating internalization: The self-		2
NA	331	Deci, Ryan (1985)			Intrinsic motivation and self-determination in human behavior	2, 3, 4, 14

Procedure and Data Analysis

The citation network analysis took place in three steps. First, based on a study using a similar methodology (Bruner et al., 2009), the original sample and the texts cited in the original sample (phase 2 texts) were entered into UCINET network analysis software (Borgatti, Everett, & Freeman, 2002). The UCINET program allows calculation of a centrality score for each article. Typically, two types of centrality scores are calculated: indegree centrality score (how many times a specific publication is cited by other publications in the population) and out-degree centrality score (how many other publications a specific publication cites) (Moore et al., 2005). A recent publication could for example have a very high out-degree centrality score if it cites many other publication, while having a very low indegree centrality score because it has not been cited by many other publications yet. A high indegree centrality score would mean that a publication is central in the citation network. Figure 6 provides an example of a centrality table (Bruner et al., 2009).

Initial model conceptualization	In-degree centrality	Out-degree centrality
Stambulova (1994)	11	0
Côté (1999)	50	1
Durand-Bush and Salmela (2002)	17	2
Wylleman, Alfermann, and Lavalée (2004)	5	3
Abbott and Collins (2004)	9	7
Bailey and Morley (2006)	0	5
Morgan and Giacobbi (2006)	0	5

Figure 6. Example of a centrality score table (Bruner et al., 2010)

Second, faction analysis was conducted to reveal possible subgroups of publications within the larger network (Borgatti et al., 2002; Hanneman & Riddle, 2005). Clusters of researchers or conceptual or methodological approaches might appear through the faction analysis. The software Netdraw (<http://www.analytictech.com/Netdraw/netdraw.htm>) was used to highlight

clusters of publications based on the number of links (citations) between nodes (articles).

Finally, the main path of literature was identified using the software Pajek (pajek.imfm.si/doku.php, e.g., Figure 7) Key publications, or “hubs” in the evolution of coaching science were revealed through mathematical examination of the highest “traversal counts” between nodes (Hummon & Dereian, 1989; Hummon & Doreian, 1990). By measuring the number of times a link between publications is involved in connecting other articles in a citation network, traversal counts highlight the main path as well as its concurrent paths in the network (Moore, Haines, Hawe, & Shiell, 2006). Unlike citation network itself that provides a snapshot of a network at a particular point, main path analysis, or ‘structurally determined most-used path’, allows researchers to evaluate the longitudinal evolution of a field.

Validity

Citation network analysis is a rather new method that is currently gaining interest from researchers across various fields. This method has recently been used in sport psychology in a two-part study led by Dr. Mark Bruner (Queen’s University, Canada), who collaborated on the present study and served on the thesis committee as an external member. Dr. Jean Côté (Queen’s University, Canada) co-authored the previous studies applying this method in sport psychology (Bruner et al., 2009a, 2009b) and also provided insight in the early stages of the present study. These two researchers therefore provided the necessary guidance to successfully apply this method while ensuring validity of the analysis.

Figure 7. Athlete development main path diagram (Bruner et al., 2009)

In addition, the thesis' first author has been extensively involved in coaching science for the past two years. The first author's main coaching science related experiences involve updating Dr Wade Gilbert's coaching science database (originally Gilbert, 2002), being an active member of a coaching science group, and presenting an overview of coaching science in North-America as part of a global symposium on coaching science at a major international conference (Rangeon et al., 2009). The thesis chair, Dr Wade Gilbert, is an internationally recognized scholar specialized in coaching science. Having authored the first comprehensive analysis of coaching science (Gilbert, 2002; Gilbert & Trudel, 2004), his deep understanding of the field ensured the quality of research methodology of the present study. The first author's and thesis chair's extensive involvement in coaching science therefore corroborates the validity of this thesis in relation to the coaching science field.

Chapter 4

RESULTS

Preliminary Notes

Due to technological limitations and a better understanding of the method since the thesis proposal was written, the method was adapted in several ways. After attending a workshop on social network analysis in the UK, a better handle of the programs Ucinet and Netdraw was gained, and led to modifications of the method. Citation network analysis is a relatively recent method relying heavily on new technologies. The author of this thesis, after discussion with the thesis chair and a committee member familiar with citation network analysis, decided to adjust the method previously written at the time of the thesis proposal. Six modifications were made to the original method (three deletions and three additions).

First, after entering the references cited in 2007 and 2008, it was found that the master list was already 3,948 references long. Ucinet being unable to handle effectively more than 5,000 references (Borgatti et al., 2002), the original sample was limited to 2007 and 2008 (instead of the proposed 2004-2008) for the purpose of this thesis.

Second, the faction analysis was not completed because its results did not seem to be reliable enough to identify unique lines of research, as publications with very high indegree centrality scores tended to be pulled by the biggest factions. A coding of publications into different topics was instead favored in order to identify more accurately the topic of each one of the top publications.

Third, the citation path analysis was tried but did not yield any useful results. Indeed, previous studies using path analysis used an original sample that was delimited by criteria other than date of publication. Using an original sample mainly delimited by date makes it impossible to conduct a citation path analysis with a big enough transversal path length. To conduct a citation path analysis using the current original sample would have required us to enter the reference lists of publications most highly cited by the original sample, in order to reach a further step in the origins of the field. It was thus decided that this analysis was outside the scope of this thesis, but could be used in a future study.

Fourth, further analyses were conducted based on the indegree centrality scores. By adding the indegree centrality scores (ICS) of publications grouped by attributes (e.g., topic, type of publication, journal, author), a cumulative indegree centrality score (CICS) for the particular attribute was obtained. For example, by adding all the ICSs of publications on a specific topic, the CICS of the research topic was computed and could be compared to the CICS of other topics.

Fifth, after learning how to create a 2-mode network during the workshop on social network analysis, this method was applied to the present dataset. A 2-mode network is based on a rectangular matrix of actors by events. For example, a 2-mode network could be created on students and the classes they have attended. Students having attended the same classes would thus be linked through their class attendance, and would appear close to each other in the network. This approach was applied in the current study to reveal how researchers (actors) are connected through collaborations on publications (events). Two types of network were therefore created in the

present study: a citation network that reveals highly cited publications (1-mode network), and collaboration network that reveals prominent researchers (2-mode network). A citation network is a directed network (paper X cites publication Y), while a collaboration network is undirected (author X and author Y have collaborated). In a 2-mode network of researchers and their publications, there is a link between researchers if they have a joint publication.

Sixth, a measure termed the ‘Researcher Influence Factor’ was created based on several indices. The 2-mode network was used as a starting point to identify researchers that could potentially be considered among the most influential researchers in the field. After pre-identifying these researchers through the 2-mode network, their CICS as well as their social capital were used to compute their RIF. The social capital of a researcher was estimated by counting the number of collaborators they have in the network.

Citation network analysis is a complex but infinitely exploitable method. Boundaries had to be set for the purpose of this thesis, but this work will be extended upon in future papers. A more detailed explanation of each analysis is provided with the presentation of the results, so it facilitates the understanding of the findings presented.

Presentation of Results

The purpose of the present study was to identify and describe the key publications and key contributors that have shaped coaching science. In order to accomplish this purpose, a citation network analysis was conducted. All the references cited by coaching science studies written in English language and published in 2007 and 2008 in peer-reviewed journals were compiled.

This publication sample represents a portrait of current coaching science literature, from which a citation network analysis was conducted. Based on this citation network analysis, the results chapter is organized into two broad sections (a) overview of the citation network and (b) analysis of key publications and key contributors.

Overview of Citation Network

The original sample of coaching science literature published in 2007 and 2008 comprised 141 articles. The coaching science citation network includes the references cited by this original sample. Figure 8 presents the citation network for the 3,891 publications cited, as well as the 2007-2008 coaching science articles citing them. Each publication is referred to as a node. The size of the circles represents the Indegree Centrality Score (ICS) of that particular text. Bigger circles represent prominent publications that tend to be cited often by coaching science articles published in 2007 and 2008.

Component analysis. A component analysis was performed to reveal the interconnectedness of the network. Components are parts of a graph that are completely disconnected from one another (Hanneman & Riddle, 2005). It revealed that the coaching science network (see Figure 8) is made of one main component (3,613 publications, in red) and 10 smaller components (278 publications). Publications in the 10 smaller components do not cite any texts in the main component and are therefore isolated from the field of coaching science as their citation patterns do not connect them to the main component of the network.

Figure 8. Citation network of publications cited by coaching articles published in 2007 and 2008, grouped by components (3,891 nodes)

Distribution of Indegree Centrality Scores (ICS). The distribution of ICSs for all 3,891 publications in the network are presented in Table 3. The distribution of ICSs shows that most publications (nodes) have a low number of connections (ICS of 1) while a few central texts earned a higher number of citations. Publications with a high number of citations (ICS) are “hubs” in the network and can be considered more prominent in the field than publications with low indegree centrality scores. This type of distribution is represented by a power law (Figure 9) and characterizes what is called a scale-free network (Barabasi & Bonabeau, 2003). In mathematical terms, any node has $1/k^n$ probability of being connected to k other nodes, n being approximately equal to 2.

Table 3. Indegree Centrality Scores

Indegree Centrality Score	Number of publications
17	1
16	1
15	1
14	1
13	1
12	2
11	0
10	3
9	11
8	5
7	15
6	19
5	37
4	45
3	122
2	425
1	3139
0	128

Figure 9. Graphic representation of the centrality scores distribution

One hundred and twenty eight publications have an indegree centrality score of '0'. This means that these publications were not cited any other publications. These publications comprise most of the 2007-2008 articles. This is expected because others in the field have not had time to integrate them into their work. Some 2007 articles were cited by 2008 articles because authors cited their own manuscripts while still in press.

Further analyses were performed on the main component of the coaching science network because it is a more accurate representation of the field (see Figure 10). Indeed, it is hypothesized that the core of the discipline lies within the main component of the network. We identified the references comprised in the smaller disconnected components as belonging to other fields. They appeared in this network only because they were cited by researchers from other fields who happened to include coaches in a study published in 2007 or 2008.

Figure 10. Main component of the citation network of publications cited by coaching science articles published in 2007 and 2008 (3,613 nodes)

In the second section of this chapter, key publications and contributors will be identified by using indegree centrality scores to reveal prominence as evidenced by high citation counts. The most cited publications will be described, as well as the recurring research topics, types of publications and outlets for the most cited publications. Authorship analysis of prominent publications reveals the key contributors to the field of coaching science.

Key Publications

Only four publications were cited by at least 10% (ICS > 13) of the original dataset of 141 articles. After a careful review of the ICSs, it was decided to extend the analysis of key publications to those cited by 5% (ICS > 6) or more of the original dataset. Forty-one publications met this criterion and serve as the dataset for identifying and describing key publications and contributors. Table A1 (see Appendix) presents the top 41 publications in terms of ICSs.

Key publications. John Lyle's book *Sports coaching concepts: A framework for coaches' behaviour* (Lyle, 2002) earned the most citations and is therefore considered the biggest "hub" of the network with an ICS of 17. Other prominent publications include Cushion, Armour, and Jones' article titled 'Coach education and continuing professional development: Experience and learning to coach' (2003) with an ICS of 16, and the Coaching Model, published by Côté and colleagues in 1995 (Côté, Salmela, Trudel, Baria, & Russell, 1995a) with an ICS of 15.

Publication topics. In order to identify the topic of these top 41 publications, the first author and a collaborator with expertise in this field of

study independently coded the topic for each publication. The coding system created by Gilbert and Trudel (2004) to analyze 30 years of coaching science was used as a provisional start list for coding the publications. In Gilbert and Trudel's research synthesis of coaching science, four main research foci were identified: behaviors, cognition, demographics, and development. These four main coaching research foci were obtained by grouping categories related to the same foci (Gilbert, 2002). For example, the behaviors focus comprised 16 categories such as coach-athlete relationship, communication, leadership style, etc. The cognition focus included 17 categories such as attitudes, knowledge, or perceptions. The development focus included 10 categories (e.g., career opportunities, intervention) and the demographics focus included 5 categories (e.g., demographics, ethnicity, gender).

In the present study, several attempts were made to code the top 41 publications by topic. The term 'topic' was preferred to the term 'focus' or 'category' as it reflects a research topic without the hierarchical relation between foci and categories used by Gilbert and Trudel (2004). After each coding attempt, the two researchers met to review their coding and discuss discrepancies. After the third attempt, the researchers achieved consensus on the code assigned to each of the publications. All the publications within the top 41 were coded into a total of 12 topics. The number of publications in each topic, as well as the topic's Cumulative Indegree Centrality Score (CICS), are reported in Table 4. Topics' CICS were computed by adding all of the Indegree Centrality Scores (ICS) of the publications belonging to a particular topic.

'Coach development' is the topic with the highest CICS (88), as well as the highest frequency count (n=10 publications within the top 41).

Table 4. Cumulative Indegree Centrality Scores (CICS) and Frequency of Topics in Top 41 Publications

Publication Topic	Cumulative Indegree Centrality Score (CICS)	Number of publications (n)	Average indegree (CICS/n)
Coach development	88	10	8.8
Sport coaching general	70	7	10
Qualitative research	51	5	10.2
Coach-athlete relationship	49	6	8.2
Coaching efficacy	28	3	9.3
Coach knowledge	23	2	11.5
General talent development	16	2	8
Coaching behaviors	15	2	7.5
General self-efficacy	10	1	10
Quantitative data analysis	9	1	9
Coach leadership	7	1	7
Professional development	7	1	7

Approximately one quarter of the publications in the top 41 directly pertain to coach development. Publications in this topic typically focus on coach education, learning, and related developmental issues for coaches.

The ‘sport coaching general’ topic earned the second highest CICS (70), and the second highest frequency count (n=7). This topic is almost exclusively represented by conceptual books (n=6). Gilbert and Trudel’s (2004) analysis of coaching science is the only non-conceptual publication in this topic, as it provided an account of coaching science through an empirical study based on content analysis. Conceptual books on sport coaching tend to focus on general conceptualizations of the coaching process from different perspectives (e.g., behavioral, cultural, holistic), while reviewing the existing literature.

Methods books on qualitative research were grouped in one topic, which earned the third highest CICS (51). However, this topic ranked 4th in terms of frequency, which is explained by a relatively high average indegree score per text (10.2 citations per publication).

Closely following the qualitative research topic, the coach-athlete relationship topic ranked 4th in CICS (49), and third if considering the number of publications only (n=6). It must be noted that Sophia Jowett is the first author for all but one of these six leading articles on coach-athlete relationship (Jowett, 2003, 2007; Jowett & Cockerill, 2003; Jowett & Meek, 2000; Jowett & Poczwardowski, 2007).

Types of publications. Within the Top 41, five types of publications were identified: conceptual article, conceptual book, methods book, research article, and research book. The term ‘conceptual’ refers to a publication that doesn’t contain a research study, while the term ‘research’ refers to a

publication in which an actual research study is presented. The term ‘method’ refers to a publication that provides guidelines to apply research methods. In the same way the CICS was computed for the different topics, the CICS per type of publication was also compiled by adding the ICS of each reference in the specific category (Table 5). Research articles obtained by far the highest CICS (CICS=179) due to the high number of references falling into this category (n=21). Conceptual books obtained a CICS of 95 and methods book obtained a CICS of 60. Books in general thus had a total CICS of 164 from adding the ICS of all 17 books in the Top 41. Articles in general obtained a total CICS of 209 from adding the ICS of all 24 articles (3 conceptual and 21 research).

Table 5. CICS, Number of Publications, and Average ICS per Type of Publication

Type of publication	CICS	Number of publications (n)	Average ICS (CICS/n)
Research article	179	21	8.5
Conceptual book	95	10	9.5
Methods book	60	6	10
Conceptual article	30	3	10
Research book	9	1	9

In order to facilitate interpretation of results, the list of the top five ranked conceptual publications and the list of the top five ranked research publications can be found in Tables 6 and 7, respectively.

Table 6. Top 5 Ranked Conceptual Publications

ICS Rank	ICS	Publication	Topic	Type of publication
1	17	Lyle, J. (2002). <i>Sports coaching concepts: A framework for coaches' behaviour</i> . London: Routledge.	Sport coaching general	Conceptual book
2	16	Cushion, C. J., Armour, K. M., & Jones, R. L. (2003). Coach education and continuing professional development: Experience and learning to coach. <i>Quest</i> , 55(3), 215-230.	Coach development	Conceptual article
3	13	Jones, R., Armour, K., & Potrac, P. (2004). <i>Sports coaching cultures: From practice to theory</i> . London, UK: Routledge.	Sport coaching general	Conceptual book
4	10	Bandura, A. (1997). <i>Self-efficacy: The exercise of control</i> . New York, NY US: W H Freeman/Times Books/ Henry Holt & Co.	General self-efficacy	Conceptual book
5	9	Cassidy, T., Jones, R., & Potrac, P. (2004). Understanding sports coaching: The social, cultural and pedagogical foundations of coaching practice. London, UK: Routledge.	Sport coaching general	Conceptual book
5	9	Horn, T. S. (2008). Coaching effectiveness in the sport domain. In T. S. Horn (Ed.), <i>Advances in sport psychology</i> (3rd ed., pp. 239-267). Champaign, IL: Human Kinetics.	Sport coaching general	Conceptual book
5	9	Trudel, P., & Gilbert, W. (2006). Coaching and coach education. In D. Kirk, M. O'Sullivan & D. McDonald (Eds.), <i>Handbook of Physical Education</i> (pp. 516-539). London, UK: Sage.	Coach development	Conceptual book

Table 7. Top 5 Ranked Research Publications

ICS Rank	ICS	References	Conceptual orientation/ topic	Type of publication
1	15	Côté, J., Salmela, J., Trudel, P., Baria, A., & Russell, S. (1995). The Coaching Model: A grounded assessment of expert gymnastic coaches' knowledge. <i>Journal of Sport and Exercise Psychology</i> , 17(1), 1-17.	Coach knowledge	Research article
2	12	Malete, L., & Feltz, D. L. (2000). The effect of a coaching education program on coaching efficacy. <i>Sport Psychologist</i> , 14(4), 410-417.	Coaching efficacy	Research article
3	10	Gilbert, W., & Trudel, P. (2001). Learning to coach through experience: Reflection in model youth sport coaches. <i>Journal of Teaching in Physical Education</i> , 21(1), 16-34.	Coach development	Research article
3	10	Mageau, G. A., & Vallerand, R. J. (2003). The coach-athlete relationship: A motivational model. <i>Journal of Sports Sciences</i> , 21(11), 883-904.	Coach-athlete relationship	Research article
4	9	Bloom, B. S. (1985). <i>Developing talent in young people</i> . New York: Ballantine.	General talent development	Research book
4	9	Feltz, D. L., Chase, M. A., Moritz, S. E., & Sullivan, P. J. (1999). A conceptual model of coaching efficacy: Preliminary investigation and instrument development. <i>Journal of Educational Psychology</i> , 91(4), 765-776.	Coaching efficacy	Research article
4	9	Jowett, S. (2003). When the "honeymoon" is over: A case study of a coach-athlete dyad in crisis. <i>The Sport Psychologist</i> , 17(4), 444-460.	Coach-athlete relationship	Research article

Table 7 (cont.)

ICS Rank	ICS	References	Conceptual orientation/ topic	Type of publication
4	9	Jowett, S., & Cockerill, I. M. (2003). Olympic medallists' perspective of the athlete-coach relationship. <i>Psychology of Sport and Exercise</i> , 4(4), 313-331.	Coach-athlete relationship	Research article
4	9	Smith, R. E., Smoll, F. L., & Curtis, B. (1979). Coach effectiveness training: A cognitive - behavioral approach to enhancing relationship skills in youth sport coaches. <i>Journal of Sport Psychology</i> , 1(1), 59-75.	Coach development	Research article
4	9	Smoll, F. L., Smith, R. E., Barnett, N. P., & Everett, J. J. (1993). Enhancement of children's self-esteem through social support training for youth sport coaches. <i>Journal of Applied Psychology</i> , 78(4), 602-610.	Coach development	Research article
5	8	Black, J. S., & Weiss, M. R. (1992). The relationship among perceived coaching behaviors, perceptions of ability, and motivation in competitive age-group swimmers. <i>Journal of Sport & Exercise Psychology</i> , 14(3), 309-325.	Coaching behaviors	Research article
5	8	Gilbert, & Trudel. (2004). Analysis of coaching science research published from 1970-2001. <i>Research Quarterly for Exercise & Sport</i> , 75(4), 388-399.	Sport coaching general	Research article
5	8	Saury, J., & Durand, M. (1998). Practical knowledge in expert coaches: on-site study of coaching in sailing. <i>Research Quarterly for Exercise & Sport</i> , 69(3), 254-266.	Coach knowledge	Research article

Publication outlets. In order to identify the most prominent outlets for influential publications in coaching science, the CICS was computed for each journal appearing in the Top 41. Only three journals have more than two articles in the Top 41: *Research Quarterly for Exercise and Sport* (CICS=30; n=4), *Journal of Sport & Exercise Psychology* (CICS=30; n=3), and *The Sport Psychologist* (CICS=28; n=3). These three journals can thus be considered journals that have been influential in shaping the field of coaching science through 2008 (Table 8).

Table 8. Outlets of Publication Ranked in Decreasing Order of CICS

Journal	Cumulative Indegree Centrality Score (CICS)	Number of publications (n)	Average ICS
<i>Research Quarterly for Exercise and Sport</i>	30	4	7.5
<i>Journal of Sport & Exercise Psychology</i>	30	3	10
<i>The Sport Psychologist</i>	28	3	9.3
<i>Quest</i>	23	2	11.5
<i>Journal of Teaching in Physical Education</i>	17	2	8.5
<i>Psychology of Sport & Exercise</i>	16	2	8
<i>Journal of Sport Sciences</i>	10	1	10
<i>Journal of Sport Psychology</i>	9	1	9
<i>Journal of Applied Psychology</i>	9	1	9
<i>Journal of Educational Psychology</i>	9	1	9
<i>International Journal of Sport Psychology</i>	7	1	7
<i>International Journal of Sport Science and Coaching</i>	7	1	7
<i>Journal of Sport Behavior</i>	7	1	7
<i>Psychological Review</i>	7	1	7

Key Researchers

A 2-mode network was created as a first step to identify key contributors to the field of coaching science (Figure 11). In a 2-mode network, actors are linked to events that they have taken part in. In this case, researchers (blue squares) are linked through publications (red dots). This type of network is undirected since links do not represent a hierarchical relation (unlike citations, collaborations are bi-directional in nature). The degree centrality score is thus not divided between in- and out-degree. Centrality score in this network represents the number of publications added to the number of connections to other researchers. However, the software Netdraw could not handle the very high number of nodes existing if the whole master list was entered. It was therefore decided that the 2-mode network would be based only on publications cited twice or more by the original sample, reducing the whole network from over 15,000 nodes to 7,204. If using a higher cut-off point such as a minimum indegree score of 3 or 4, evidence of connectedness, or lack thereof, would have been lost.

The degree centrality score of each node was computed and represented by a bigger node for higher centrality scores. The biggest squares show the authors with a centrality score superior to 10. This 2-mode network also shows how the field of coaching science is shaped through collaborations between researchers. The layout of the network revealed that researchers and publications isolated from the field congregate to the center of the network in a disconnected cluster. The outer ring, on the opposite, represents the most active researchers in coaching science. As the ring shape suggests, coaching science is a small world where key contributors in the field are linked through collaborations to intermediate connections (brokers).

Figure 11. 2-mode network representing links between contributors through co-authorship

Although informative, simply adding the number of publications to the number of connections does not accurately represent the prominence of a researcher. This 2 mode network was only used as an indication of potentially prominent researchers, for which a more complete measure of prominence was used. The Researcher Influence Factors (RIF, see Equation 1) was calculated by adding the CICS of publications written as a first author (CICS) to the CICS of publications written as a secondary author (CICS/2), to the number of connections to other researchers through collaborations on publications cited by the original sample (# of collaborations). Although arbitrary, it was decided that dividing the CICS of publications written as a secondary author would adequately represent the different amount of work first and secondary authors put into a publication. We must however recognize that involvement of secondary authors in a publication can vary greatly, which makes this division by two a very simplified way of taking this phenomenon into account.

$$\text{Eq. 1 -- Researcher Influence Factor (RIF)} = \text{CICS primary author} + (\text{CICS secondary author})/2 + N \text{ connections}$$

Table 9 shows the most influential researchers, earning a prominence factor above 70. This number was used as a cut-off point because the RIF significantly dropped by 13 points for the next ranked contributor. This cut-off point also allowed us to highlight the Top 10 ranked contributors to the field.

Further information such as gender and current affiliation of the top 10 ranked researchers is presented in Table 10. A graphic representation of the top ranked researchers in coaching science is provided in Figure 12, and a

geographical representation is shown in Figure 13. All of the most prominent researchers are either affiliated with an American (n=7), Canadian (n=2), or British university (n=2).

Table 9. Most Influential Researchers in Coaching Science, Ranked by Decreasing Order of Researcher Influence Factor (RIF)

Contributor Rank	Researcher	Primary author CICS	Secondary author CICS	Connections (n)	RIF
1	Dan Gould	67	7.5	50	124.5
2	Sophia Jowett	87	2.5	21	110.5
3	Ronald Smith	64	18	15	97
4	Jean Côté	56	9.5	25	90.5
5	Packianathan Chelladurai	49	16	23	88
6	Pierre Trudel	20	43	22	85
7	Deborah Feltz	24	26	24	74
8	Frank Smoll	27	32.5	13	72.5
9	Maureen Weiss	30	11.5	30	71.5
10	Robyn Jones	33	24.5	13	70.5
10	Wade Gilbert	54	7.5	9	70.5

To conclude, a small number of publications can be identified as hubs in the network of coaching science. These publications are influencing current researchers who in return cite them in their research papers. A small set of influential researchers in coaching science has also been identified. The most relevant findings will be discussed in detail in chapter 5.

Table 10. Demographic Information of the Top 10 Ranked Researchers in Coaching Science

Contributor Rank	Researcher	Gender	Academic department/school	Current affiliation	Country of affiliation	Year of PhD	Country of PhD
1	Dan Gould	Male	Kinesiology	Michigan State University	USA	1978	USA
2	Sophia Jowett	Female	Sport, exercise and health sciences	Loughborough University	Great Britain	2001	Great Britain
3	Ronald Smith	Male	Psychology	University of Washington (WA)	USA	1968	USA
4	Jean Côté	Male	Kinesiology and health studies	Queen's University	Canada	1993	Canada
5	Packianathan Chelladurai	Male	Physical activity and educational services	Ohio State University	USA	1978	Canada
6	Pierre Trudel	Male	Human Kinetics	University of Ottawa	Canada	1987	Canada
7	Deborah Feltz	Female	Kinesiology	Michigan State University	USA	1980	USA
8	Frank Smoll	Male	Psychology	University of Washington (WA)	USA	1970	USA
9	Maureen Weiss	Female	Kinesiology	University of Minnesota	USA	1981	USA
10	Robyn Jones	Male	Sport	University of Wales Institute	Great Britain	1992	USA
10	Wade Gilbert	Male	Kinesiology	California State University, Fresno	USA	1999	Canada

Figure 12. Graphic representation of most influential researchers, ranked by decreasing order of RIF

Figure 13. Geographical representation of the top coaching science researchers, based on their current academic affiliation

Chapter 5

DISCUSSION

The field of social network analysis finds its origin in graph theory, which has been used by scientists to analyze relationships between actors. Many different types of actors have been the subject of study through social network analysis, such as people, molecules, computers, websites, and publications, (Delwiche, 2003; Edwards, 1999; Moore et al., 2005). Types of relationships studied are also very broad, from friendship to drug dealing, through collaborations on research publications or citations. Many of these networks are qualified as scale-free because they have a power-law degree distribution and a short average path length. In the case of a citation network analysis, a scale-free network shows the high influence of few studies, while many other publications receive very low attention from the scientific community in question. The structure of coaching science is that of a scale-free network, having only a few key publications influencing the field and many publications that do not receive more than one citation. Compelling findings related to the most cited publications, recurring topics, key journals and most influential authors will be discussed in further detail.

Most Cited Publications

Analysis of the most cited studies revealed the importance of the coaching model (Côté et al., 1995b), which shows that researchers favor an empirically grounded model. This type of model has been termed a model 'of' coaching, in opposition to models 'for' coaching, the latter being idealistic representations of the coaching process (Cushion, Armour, & Jones, 2006;

Lyle, 2002). This shows that amongst the multiple attempts to model the coaching process, researchers tend to give more importance to models based on empirical evidence. Despite Cushion's opinion that the field is lacking a consensual model (Cushion, 2007), it seems that the coaching model is the one gaining the most attention from researchers.

Recurring Topics

The importance of publications on coach development compared to other topics illustrates one of the main questions underlying coaching research: How does one become a good coach? A previous synthesis of coaching science has identified coaches' behaviors as the main research interest from 1970 to 2001 (Gilbert & Trudel, 2004). It seems that the field's main concern is now switching to developmental questions rather than mere behavioral observations. This switch in research interest is sign of a growing field moving from descriptive observation studies to a deeper quest for understanding dynamic processes of an individual's learning and development. Publications about sport coaching in general were also very present in the top 41. Publications describing the coaching process from a general standpoint receive high citations because they help researchers situate their work in the broader picture of the field. Books are particularly common in this topic as it typically takes more than 25 pages to describe the sports coaching process. The only journal article found in the 'general coaching' topic was Gilbert and Trudel's analysis of coaching science, which described coaching science from 1970 to 2001 based on a content analysis of empirical studies on coaches (Gilbert & Trudel, 2004).

Method books on qualitative research were found to have relatively high average CICS. Gilbert and Trudel (2004) already suggested an epistemological shift in coaching science. No research studies on coaches were using qualitative data analysis in the 1970's (Gilbert & Trudel, 2004). This complete absence was then followed by a gradual increase in popularity of qualitative methodologies to study coaches (28.8% in 1998 to 2001). The high citation count of qualitative methods books in the present study also reflects this epistemological shift from a complete dominance of quantitative studies to a more equal repartition of types of methods. The CICS of qualitative methods books in the top 41 was equal to 51, while only one quantitative methods book appeared in the top 41, earning an ICS of 9. One might wonder if such a high CICS for qualitative methods books can be the result of qualitative research being sometimes considered as "less scientific", thus leading researchers to back up their methodology by referencing a set of highly recognized references in qualitative research. Quantitative researchers, on the other hand, might not feel the same need to cite so many references in their method section since because statistics are commonly accepted as valid and reliable without having to cite the original reference of the methods used.

Top Journals That Have Shaped the Field

Results show that *Research Quarterly for Exercise and Sport*, the *Journal of Sport & Exercise Psychology*, as well as *The Sport Psychologist* have been particularly influential in shaping coaching science. However, this measure reflects which journals were influential in the past, without necessarily still being considered the main outlets to publish coaching

science. *The International Journal of Sports Science and Coaching*, for instance, has been shown to be the biggest publisher of coaching science studies in the past five years (Rangeon et al., 2009). Only one article from this journal appeared in the top 41 (at least partially due to this journal having been created in 2006), hence reflecting the discrepancy between journals that have been influential in shaping coaching science, and journals that are currently shaping the field.

The tight link between coaching science and sport psychology is evidenced by the list of journals highlighted in the present study. Indeed, half of the journals appearing in the Top 41 are sport psychology journals. Other fields include physical education, psychology, and sports science in general.

Impact factor. The impact factor of scientific journals is published annually by the Institute for Scientific Information (ISI). It is defined as “the average number of current citations to articles the journal published in the previous two years” (ISI, 2000). For example, to calculate the 2010 impact factor of the *IJSSC*, the number of times articles published in 2008 and 2009 are cited by indexed journals in 2010 would be divided by the total number of articles published in 2008-2009 in the *IJSSC*. The evident issue here is that many important journals focusing on sport studies and coaching science in particular are not indexed by the ISI. Calculating the impact factor of sport studies or coaching science journals would therefore become a daunting task requiring countless hours of entering references from an extensive list of journals potentially citing *IJSSC* papers. The impossibility of using the ‘true’ impact factors calculated every year by ISI makes the ‘modified impact factor’

of the present study a practical alternative for identifying influential outlets in coaching science.

Influential Researchers

A list of important contributors to coaching science in the past 30 years had been previously published (Gilbert, 2002). A weakness of this previous measure is that it only took into consideration the number of coaching articles published by each researcher. Some researchers could for example have a high number of published articles, but have a very low ICS for all of those publications. Another researcher could on the other hand publish very few articles, but with each article receiving a lot of attention from other researchers. In consequence, an updated and more complete measure of researchers' prominence was needed to have a more accurate representation of the key contributors in the field. The Research Impact Factor (RIF) was created in an effort to highlight researchers' prominence based on the number of citations their publications receive, as well as their social capital.

The h-Index Compared to the RIF

An index called the h-index is, to our knowledge, the closest measure to the RIF. The h-index takes into consideration the entire list of an author's publications in decreasing order of ICS, and counts how many (h) papers have been cited h or more times (Henzinger, Suñol, & Weber, 2010; Saad, 2010). This index thus takes into account not only the number of publications, but also their prominence as measured by ICS. The h-index of many researchers can be calculated on the ISI Web of Knowledge (isihighlycited.com), although no coaching science researchers seem to be indexed in this database. Since Google Scholar also references citations to

articles, this online database could potentially be used to calculate the h-index. In addition to limitations due to the use of scientific databases themselves, further shortcomings of the h-index need to be acknowledged. Indeed, the h-index takes into consideration only the most cited publications of a researcher. In addition, calculation of the h-index does not discriminate between primary and secondary author. Even though some of the h-index's shortcomings cannot be resolved, the RIF appears to be a more complete and accurate representation of a researcher's impact in a given field. By starting from an original sample portraying the current, or at least recent, state of a field (here coaching science) out of which a citation network is drawn, the RIF does not rely on a database such as Web of Science or Google Scholar, thereby bringing the limitations of the given database into the measure. Besides, the RIF does not look at either the whole set of publications of a researcher or a select few of the highly cited publications. Instead, the RIF indexes work cited by a particular sample that is clearly identified by criteria such as coaching science studies written in English language and published in 2007 and 2008 in peer-reviewed journals. Moreover, where the h-index allocates the same 'points' whether a researcher is the main author or not, the RIF divides by two the number of ICS 'points' for a secondary author, as compared to full credit for the first author. Finally, in addition to allocating 'points' for citations earned by a researcher's publications, the RIF also includes a measure of social capital.

Social Capital of Researchers

The RIF does not just take into consideration the CICS of an author's publications, but also the social capital of the author. Social capital of

researchers has commonly been measured based on the connections a particular researcher has to other researchers through collaboration on a publication (Grenfell, 2009; Nahapiet & Ghoshal, 1998). Across fields, having a high social capital has been shown to be associated with several advantages such as faster promotions, higher salary, and more opportunities to learn and disseminate ideas (Grenfell, 2009; Johnson & Duff, 2005; Nguyen, Allen, & Godkin, 2006). A researcher with a higher social capital therefore has better chances of communicating his/her research to a larger population, thereby increasing the impact of the findings. An increase in direct relationships (measured by co-authorship) provides a researcher with more possibilities to share resources with other researchers (Nahapiet & Ghoshal, 1998), as well as better access to new knowledge and opportunities.

Even though the RIF seems to be a fairly accurate representation of a researcher's influence, this measure could potentially be improved. For instance, rather than simply measuring the number of connections to other researchers, these connections could be weighted by the RIF of the authors one is connected to. Indeed, being connected to an influential researcher should be more important than being connected to a researcher with little or no influence on the field. Some authors can for example have many connections to their graduate students, which would not be as important as having a lower number of connections but to other researchers in the Top 10.

In addition, the RIF doesn't take into consideration self-citations. Scores might be skewed for some researchers who tend to cite themselves a lot.

Most Influential Authors in Coaching Science

By calculating the RIF of the top researchers in the field, we obtained a list of eleven researchers, ranked from number 1 to number 10 (two researchers came in 10th). Demographic information about these researchers showed the field to be male-dominated as well as North-America-dominated. Indeed, only 3 of the 11 researchers were women. This result is not surprising, considering that sport in general, and coaching in particular, is an activity highly dominated by men (Coakley, 2008).

The academic departments of current affiliation showed that almost all of the researchers are employed in kinesiology or similar departments. The only two exceptions were Ronald Smith and Frank Smoll from the department of psychology at the University of Washington. Having both extensive backgrounds in sport as athletes and coaches, it is not surprising to see that their main research focus is related to sports despite working in a psychology department. In addition, their research has been primarily focusing on psychosocial outcomes (e.g., anxiety, satisfaction, self-esteem) of youth sport participants (Munsey, 2010).

Countries of current affiliation revealed a clear dominance of the USA, with more than half of the top 10 ranked researchers being currently affiliated with American universities. The four researchers being currently affiliated with universities outside of the USA are Jean Côté and Pierre Trudel from Canada, as well as Sophia Jowett and Robyn Jones from Great Britain. However, two researchers being currently affiliated with American universities obtained their Ph.D. in Canada (Packianathan Chelladurai and Wade Gilbert). In terms of specific universities, Michigan State University seems to be particularly active in coaching science, with notably Dan Gould

and Deborah Feltz. The University of Ottawa also seems to be one of the “hotbeds” of coaching science, with Pierre Trudel as a professor, and Jean Côté and Wade Gilbert having obtained their PhD from this university. The mobility of researchers could be further investigated by looking at previous affiliations. For example, some researchers might originate from countries that do not appear in current affiliations or PhD alma maters, such as Greece for Sophia Jowett or India for Packianathan Chelladurai. This phenomenon could potentially reflect a brain drain to the benefit of countries where coaching science is already popular. In addition, temporary affiliations of researchers in different countries can be an indicator of a researcher’s social capital. Examples include Robyn Jones who spent some time at the University of Otago, New Zealand and at the University of Oslo, Norway, or Jean Côté who spent some time at the University of Queensland, Australia.

The dominance of the USA, Canada and Great Britain could on the one hand be the sign of language barriers that prevents researchers from non-English speaking countries from publishing. On the other hand, we can hypothesize that this Anglophone preeminence is at least partly due to a lower interest for coaching science in other countries. Indeed, an analysis of coaching science articles published in French revealed that 10 times less articles were published in French than in English (Cloes et al., 2009). As suggested in this study, the interest, or lack thereof, that the French speaking scientific community gives to studying coaching is influenced by a professionalization of coaching that is a lot more advanced in North-America compared to some countries in Europe (Cloes et al., 2009).

The academic age of a researcher is represented by the year when the Ph.D was obtained. Even though it does not necessarily reflect the actual age of a researcher, it suggests the number of years a researcher has been active in publishing research. As previously mentioned, Ronald Smith and Frank Smoll are some of the “fathers” of coaching science, having both obtained their Ph.D around 1970. The following generation, with Ph.D graduations around 1980 include Dan Gould, Packianathan Chelladurai, Deborah Feltz, and Maureen Weiss. Pierre Trudel, Robyn Jones, and Jean Côté make up the third generation, having all obtained their Ph.Ds around 1990. Finally the most recent generation of influential coaching science researchers includes Wade Gilbert and Sophia Jowett, having both obtained their Ph.D around 2000.

Conclusion

Several key findings can be once again highlighted:

- Coaching science takes the form of a scale-free network, where very few references can be considered hubs of the network.
- Despite a lack of a consensual model of the coaching process that has been described by several researchers (C. Cushion, 2007; Lyle, 2002), Côté’s Coaching Model is cited by over 10% of recent coaching science articles.
- Research on coach development seems to be particularly active in 2007 and 2008, as the CICS of this topic is relatively high compared to other topics.
- The most influential researchers in coaching science are predominantly male and affiliated with American Universities. Four

successive generations of influent researchers in coaching science have been identified. Smith and Smoll can be considered as some of the “fathers” of coaching science, while Jowett and Gilbert are younger researchers whose work is already receiving great attention in the field.

To conclude, coaching science is highly influenced by a small set of key publications and researchers. Becoming acquainted with this list of publications and researchers could be very useful for practitioners looking to improve their work. Researchers and students can also use these findings to identify important publications and gain a broader perspective of the field. In the future, the same study could be repeated to analyze the evolution of the field. Since the seventies when research on coaches slowly started, researchers’ interest has shifted from a focus on behaviors (Gilbert, 2002; Gilbert & Trudel, 2004), to more varied interests nonetheless dominated by research on coach development. An epistemological shift from a complete dominance of quantitative research to a more balanced field between quantitative and qualitative research is suggested by the results of the present study, but need to be confirmed by complementary analyses.

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APPENDIX

Table A1. Top 41 Publications Ranked by Decreasing Indegree Centrality Score (ICS)

ICS	Publication	Publication Topic	Type of publication
17	Lyle, J. (2002). <i>Sports coaching concepts: A framework for coaches' behaviour</i> . London: Routledge.	Sport coaching general	Conceptual book
16	Cushion, C. J., Armour, K. M., & Jones, R. L. (2003). Coach education and continuing professional development: Experience and learning to coach. <i>Quest</i> , 55(3), 215-230.	Coach development	Conceptual article
15	Côté, J., Salmela, J., Trudel, P., Baria, A., & Russell, S. (1995). The Coaching Model: A grounded assessment of expert gymnastic coaches' knowledge. <i>Journal of Sport and Exercise Psychology</i> , 17(1), 1-17.	Coach knowledge	Research article
14	Miles, M. B., & Huberman, A. M. (1994). <i>Qualitative data analysis: An expanded sourcebook</i> (2nd ed.). Thousand Oaks, CA: Sage.	Qualitative research	Methods book
13	Jones, R., Armour, K., & Potrac, P. (2004). <i>Sports coaching cultures: From practice to theory</i> . London, UK: Routledge.	Sport coaching general	Conceptual book
12	Malete, L., & Feltz, D. L. (2000). The effect of a coaching education program on coaching efficacy. <i>Sport Psychologist</i> , 14(4), 410-417.	Coaching efficacy	Research article
12	Patton, M. Q. (1990). <i>Qualitative evaluation and research methods</i> (2nd ed.). Thousand Oaks, CA: Sage.	Qualitative research	Methods book
10	Bandura, A. (1997). <i>Self-efficacy: The exercise of control</i> . New York, NY US: W H Freeman/Times Books/ Henry Holt & Co.	General self-efficacy	Conceptual book
10	Gilbert, W., & Trudel, P. (2001). Learning to coach through experience: Reflection in model youth sport coaches. <i>Journal of Teaching in Physical Education</i> , 21(1), 16-34.	Coach development	Research article
10	Mageau, G. A., & Vallerand, R. J. (2003). The coach-athlete relationship: A motivational model. <i>Journal of Sports Sciences</i> , 21(11), 883-904.	Coach-athlete relationship	Research article

Table A1 (cont).

ICS	Publication	Publication Topic	Type of publication
9	Bloom, B. S. (1985). <i>Developing talent in young people</i> . New York: Ballantine.	General talent development	Research book
9	Cassidy, T., Jones, R., & Potrac, P. (2004). Understanding sports coaching: The social, cultural and pedagogical foundations of coaching practice. London, UK: Routledge.	Sport coaching general	Conceptual book
9	Feltz, D. L., Chase, M. A., Moritz, S. E., & Sullivan, P. J. (1999). A conceptual model of coaching efficacy: Preliminary investigation and instrument development. <i>Journal of Educational Psychology</i> , 91(4), 765-776.	Coaching efficacy	Research article
9	Horn, T. S. (2008). Coaching effectiveness in the sport domain. In T. S. Horn (Ed.), <i>Advances in sport psychology</i> (3rd ed., pp. 239-267). Champaign, IL: Human Kinetics.	Sport coaching general	Conceptual book
9	Jowett, S. (2003). When the "honeymoon" is over: A case study of a coach-athlete dyad in crisis. <i>The Sport Psychologist</i> , 17(4), 444-460.	Coach-athlete relationship	Research article
9	Jowett, S., & Cockerill, I. M. (2003). Olympic medallists' perspective of the athlete-coach relationship. <i>Psychology of Sport and Exercise</i> , 4(4), 313-331.	Coach-athlete relationship	Research article
9	Lincoln, Y. S., & Guba, E. G. (1985). <i>Naturalistic inquiry</i> . Newbury Park, CA: Sage.	Qualitative research	Methods book
9	Smith, R. E., Smoll, F. L., & Curtis, B. (1979). Coach effectiveness training: A cognitive - behavioral approach to enhancing relationship skills in youth sport coaches. <i>Journal of Sport Psychology</i> , 1(1), 59-75.	Coach development	Research article

Table A1 (cont).

ICS	Publication	Publication Topic	Type of publication
9	Smoll, F. L., Smith, R. E., Barnett, N. P., & Everett, J. J. (1993). Enhancement of children's self-esteem through social support training for youth sport coaches. <i>Journal of Applied Psychology</i> , 78(4), 602-610.	Coach development	Research article
9	Tabachnick, B. G., & Fidell, L. S. (2007). <i>Using multivariate statistics (5th ed.)</i> . Boston, MA: Allyn & Bacon/Pearson Education.	Quantitative data analysis	Methods book
9	Trudel, P., & Gilbert, W. (2006). Coaching and coach education. In D. Kirk, M. O'Sullivan & D. McDonald (Eds.), <i>Handbook of Physical Education</i> (pp. 516-539). London, UK: Sage.	Coach development	Conceptual book
8	Black, J. S., & Weiss, M. R. (1992). The relationship among perceived coaching behaviors, perceptions of ability, and motivation in competitive age-group swimmers. <i>Journal of Sport & Exercise Psychology</i> , 14(3), 309-325.	Coaching behaviors	Research article
8	Creswell, J. W. (1998). <i>Qualitative inquiry and research design: Choosing among five traditions</i> . Thousand Oaks, CA US: Sage Publications, Inc.	Qualitative research	Methods book
8	Gilbert, W., & Trudel, P. (2004). Analysis of coaching science research published from 1970-2001. <i>Research Quarterly for Exercise & Sport</i> , 75(4), 388-399.	Sport coaching general	Research article
8	Patton, M. Q. (2002). <i>Qualitative research & evaluation methods</i> (3rd ed.). Thousand Oaks, CA: Sage.	Qualitative research	Methods book
8	Saury, J., & Durand, M. (1998). Practical knowledge in expert coaches: on-site study of coaching in sailing. <i>Research Quarterly for Exercise & Sport</i> , 69(3), 254-266.	Coach knowledge	Research article

Table A1 (cont).

ICS	Publication	Publication Topic	Type of publication
7	Bloom, G. A., Durand-Bush, N., Schinke, R. J., & Salmela, J. H. (1998). The importance of mentoring in the development of coaches and athletes. <i>International Journal of Sport Psychology</i> , 29, 267-281.	Coach development	Research article
7	Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. <i>Psychological Review</i> , 100(3), 363-406.	General talent development	Conceptual article
7	Gilbert, W., Côté, J., & Mallett, C. (2006). Developmental Paths and Activities of Successful Sport Coaches. <i>International Journal of Sports Science & Coaching</i> , 1(1), 69-76.	Coach development	Research article
7	Gilbert, W., & Trudel, P. (1999). An evaluation strategy for coach education programs. <i>Journal of Sport Behavior</i> , 22(2), 234.	Coach development	Research article
7	Gould, D., Krane, V., Giannini, J., & Hodge, K. (1990). Educational needs of elite U.S. national team, pan American, and olympic coaches. <i>Journal of Teaching in Physical Education</i> , 9(4), 332-344.	Coach development	Research article
7	Jowett, S. (2007). Interdependence analysis and the 3+1Cs in the coach-athlete relationship. In S. Jowett & D. Lavalley (Eds.), <i>Social psychology in sport</i> (pp. 15-27). Champaign, IL: Human Kinetics.	Coach-athlete relationship	Conceptual book
7	Jowett, S., & Meek, G. A. (2000). The Coach-Athlete Relationship in Married Couples: An Exploratory Content Analysis. <i>Sport Psychologist</i> , 14(2), 157.	Coach-athlete relationship	Research article
7	Jowett, S., & Poczwardowski, A. (2007). Understanding the coach-athlete relationship. In S. Jowett & D. Lavalley (Eds.), <i>Social psychology in sport</i> (pp. 3-14). Champaign, IL: Human Kinetics.	Coach-athlete relationship	Conceptual book

Table A1 (cont).

ICS	Publication	Publication Topic	Type of publication
7	Lyle, J. (1999). The coaching process: An overview. In N. Cross & J. Lyle (Eds.), <i>The coaching process: Principles and practice for sport</i> (pp. 3-24). Oxford, UK: Butterworth Heinemann.	Sport coaching general	Conceptual book
7	Myers, N. M., Vargas-Tonsing, T. M., & Feltz, D. L. (2005). Coaching efficacy in intercollegiate coaches: Sources, coaching behavior, and team variables. <i>Psychology of Sport & Exercise</i> , 6(1), 129-143.	Coaching efficacy	Research article
7	Potrac, P., Brewer, C., Jones, R., Armour, K., & Hoff, J. (2000). Toward an holistic understanding of the coaching process. <i>Quest</i> , 52(2), 186.	Sport coaching general	Conceptual article
7	Riemer, H. A., & Chelladurai, P. (1998). Development of the Athlete Satisfaction Questionnaire (ASQ). <i>Journal of Sport & Exercise Psychology</i> , 20(2), 127.	Coach leadership	Research article
7	Schön, D. A. (1987). <i>Educating the reflective practitioner: Toward a new design for teaching and learning in the professions</i> . San Francisco, CA: Jossey-Bass.	Professional development	Conceptual book
7	Smith, R. E., Smoll, F. L., & Hunt, E. (1977). System for the behavioral assessment of athletic coaches. <i>Research Quarterly for Exercise & Sport</i> , 48(2), 401-407.	Coaching behaviors	Research article
7	Wiersma, L. D., & Sherman, C. P. (2005). Volunteer Youth Sport Coaches' Perspectives of Coaching Education/Certification and Parental Codes of Conduct. <i>Research Quarterly for Exercise & Sport</i> , 76(3), 324-338.	Coach development	Research article

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