New Ideas for High Performance Coaches: A Case Study of Knowledge Transfer in Sport Science

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ABSTRACT

Research related to how coaches learn concludes that coaches most often learn from other coaches. So far, there has been little evidence to suggest that coaches rely on sport scientists for their information, which would indicate minimal interaction between sport scientists and coaches. The purpose of this study was to determine the type and source of new ideas that high-performance coaches use to understand the extent to which sport science is the source of those ideas. This project utilized a single case study design involving a group of 20 high-performance coaches in 12 different sports in a university environment, which one would expect to be conducive to interaction between sport scientists and coaches. The method included the administration of a questionnaire, followed by a structured personal interview. Our findings suggest that these coaches do believe that sport science can contribute to coaching, are interested in having a sport scientist work with them, and are motivated to find and implement new ideas in their sport programs. Despite this, most of the respondents indicated they usually get those new ideas from other coaches, or from coaching clinics and seminars, and not from sport scientists or their written work. Reasons stated included a lack of time to look for new ideas and hence the use of expedient sources, and a lack of interest in academic publications.

Key words: Coach Education, Informal Learning, Mentoring, Sports Science, Unmediated Learning

INTRODUCTION

Success in high-performance sport is socially and financially rewarded in most countries, and therefore the search for the "winning edge" is a global concern for high-performance athletes. The coaches of those athletes are assumed to be motivated to acquire new ideas to improve their athletes' performance and progress toward their mutual goal of competitive success. Researchers in the sport sciences assume the role of knowledge creators and thereby attempt to contribute new ideas that lead to improvements in coaching and training

techniques in high performance sport. The unknown factor is how effectively the knowledge created by the sport scientist is transferred to, or acquired by, the coach.

Previous research on coaching has contributed to the understanding of coaches' knowledge acquisition by suggesting that coaches acquire knowledge through various processes including mentorship by other coaches [1-3], through their experience as athletes [4-7], through coaching experience and reflection [8-14] and from formal coach education [6, 15, 16]. Based on the results of these studies, we believe that coaches in the high-performance domain have been predominantly influenced by other elite coaches, either through formal or informal mentoring or observation. What remains unclear is the relative importance of the various knowledge acquisition processes used by high performance coaches, and specifically how sport scientists fit into the process. In a recent study, Williams and Kendall [21] concluded that "congruence between the perspective of elite coaches and sports science researchers in this study is encouraging" (p. 1585), but suggest the unique environment within which the study was done (the Australian Institute of Sport) may have influenced the results, as sport scientists are pressured to cooperate with coaches in the research process. Nevertheless, their result seems encouraging and merits study in other environments.

If a primary source of new ideas is other coaches [11] it is important to know whether this source of new ideas is actively chosen by all coaches or is only accessed most frequently due to convenience or a lack of other options. Why do coaches looking for new ideas prefer to use other coaches as a resource over getting new ideas from sport scientists? Irwin et al. [11] make minimal reference to coaches approaching sport scientists for information, and suggest they only do so in the context of experimentation. Whereas research suggests that coaches learning from other coaches is the dominant practice [1, 3, 10, 11], there is no empirical evidence offered to explain why coaches prefer to learn in this way. Other learning options are available [4] including coach education courses, trial and error, critical reflection, experimentation, written resources, video and the internet. Nevertheless, the coach-to-coach information exchange dominates. There is some research that considers "how coaches learn", more generally, and processes such as critical reflection and personal experimentation have been studied. Whereas these theories offer suggestions as to learning processes, there is little empirical evidence supporting them at this time, and they do not really pertain to how coaches seek new ideas at any particular point in time. Therefore, there is a need to know whether self-reported self-education efforts of coaches reflect any of these theoretical suggestions.

Werthner and Trudel [17] proposed a view of how coaches learn using three types of learning situations: mediated, unmediated and internal. The mediated situation is learning that is guided or led by an instructor or facilitator in a setting such as a workshop, clinic or seminar. That is, the information that a coach receives is "mediated" by an instructor. Unmediated learning is when the learner seeks out the information directly and then personally uses the knowledge to develop and test new ideas. When coaches independently and proactively look for, find, evaluate and implement new ideas, this would be classified as being an unmediated learning situation. Internal learning is self-reflection, and the learner reconsiders and rearranges existing knowledge and experiences to develop a new idea.

While these three types of learning situations describe the options available to coaches, there is minimal evidence indicating which of these types of learning high performance coaches use, or prefer.

Werthner and Trudel [17] provide a fictitious example of an experienced elite-level coach who is constantly looking to upgrade knowledge he or she specifically needs at a given point in time. They suggest that the topic will be determined by the coach, possibly based on some emergent issue, and the learning process may be self-directed. According to Werthner and Trudel [17], "unmediated learning situations should be considered an important way to learn because the meaningfulness of the material of learning is probably high" (p. 204), but they raise a note of caution by suggesting the effectiveness of unmediated learning may depend upon "coaches' ability to learn by themselves, their openness and eagerness to create new learning opportunities, and the fact that coaches cannot look for information on a topic if they do not know it exists" (p. 204). The possibility that unmediated learning situations may be the high-performance coaches' most commonly used learning process legitimates the need for empirical investigation of this process. Our study investigates whether sport science knowledge is being actively disseminated to coaches to consider (in a mediated learning situation), or if coaches are proactively seeking and acquiring this knowledge in an unmediated way.

Irwin et al. [11], Cushion et al. [10] and others suggest that the less experienced coaches tend to access more experienced coaches, but this pyramid-style knowledge transfer model obviously has pragmatic limitations when a coach's experience grows, leading to the question of where the most experienced high-performance coaches go for new ideas. It may be that coach-to-coach knowledge acquisition or transfer is recognized as the prevailing learning process for coaches because the coaches who are mostly likely to benefit from such interaction constitute a large majority comprising introductory and developmental coaches. If we put our confidence in such a knowledge transfer system, it is possible that a sport system's most advanced and knowledgeable coaches might eventually exhaust their sources of relevant information or new ideas. Our confidence might be misplaced and we might need to re-evaluate the idea that all coaches in a sport system can get the information they want through coach-to-coach knowledge transfer, and ask whether the high-performance coaches have the appropriate strategies in place to acquire the knowledge their group specifically needs.

An obvious direct source of new ideas for the top high-performance coaches are the sport scientists and the knowledge they create through their research endeavours. Sport science research findings are being presented in a variety of primarily scientific outlets including scholarly journals and academic conferences. Coaches could access these outlets, but it is also possible that highly experienced and educated coaches are not interested in the knowledge created by sport scientists, or the outlets the sport scientists use. Therefore, an inquiry into the coaches' level of interest in sport science is worthy of investigation, but the extent to which coaches interact with researchers in the sport sciences, access the scientific evidence, and put that evidence into practice has not often been the subject of empirical inquiry. However, in a recent study, Williams and Kendall (2007) found, within the context of elite coaching in Australia, a level of consultation and cooperation between coaches and researchers. We believe this is a significant finding as it appears to be the first published empirical evidence of a successful relationship between high-performance coaches and sport scientists.

Beyond the preferred learning process, there is a second part to the knowledge transfer process to consider, and that is the content of the knowledge and the type of new ideas that are being sought. Knowledge of potential interest to high-performance coaches has traditionally been classified in coach education programs such as the National Coaching Certification Program [22] into several broad areas including drills for individual skill development, tactics, strategies, exercise physiology, sport psychology, and sport biomechanics. Whereas all of these areas are undeniably important in the development of sport performance, with the exception of the study by Williams and Kendall [21], no studies have been done that have asked high-performance coaches to identify which areas of knowledge are most important to them.

Furthermore, whereas we are interested in the contribution of sport science as a source of knowledge to coaches, we will also consider whether the source that a coach uses could depend upon the type of knowledge they require. The study by Irwin, et al. [11] of elite gymnastics coaches found that "the method of gaining more knowledge would be generally dependent upon the nature of the question" (p. 436). It seems likely, for example, that the sources of knowledge accessed to develop new competitive strategies might be different from the sources required for questions about motivation or physical training of athletes. The same authors also noted that high-performance coaches are usually experienced and have a substantial base of preparation and knowledge, so new ideas in any particular domain might be difficult for them to find. A better understanding of the goals and processes typically used by coaches will enhance the possibility of knowledge providers transferring the required information to coaches through their preferred channels in a timely manner.

The purpose of this research was to determine where and how coaches of highperformance athletes look for new ideas and the types of ideas they are interested in. We were specifically interested in the coaches' opinions regarding the contributions made by sport scientists as a source of new ideas, the difficulties they encounter in finding and implementing new ideas, and their thoughts about the knowledge transfer process. It is believed that exploring these questions will contribute to the ongoing development of an efficient knowledge transfer (acquisition) strategy for high-performance coaches.

METHOD

In Canada, coaches of high-performance athletes (defined as national team or junior national team athletes) are employed by national and provincial sport organizations, sport clubs, colleges and universities. The vast majority of sport scientists are employed by universities. Therefore, if knowledge transfer between sport coaches and scientists is occurring, it is reasonable to argue that the most likely place for it to occur is at the universities that employ both. To explore this knowledge transfer process, a single case study design was used. Researchers generally agree that single case study designs are useful when how or why questions are being posed, the question is exploratory, and the question is situated in a reallife context [18]. The real-life context of this case can be described as one Canadian university with a Faculty of Physical Education and Recreation that employed a group of full-time coaches, all of whom were invited to participate in the study. In this Faculty of Physical Education and Recreation, the coaches participate as both coaches and teachers alongside other members of the academic staff, many of whom are directly involved in knowledge creation and dissemination in sport science. This case and this sample of coaches was purposively selected because, among coaches, if any have easy access to sport science, it would be those based in universities, in faculties where sport science is conducted. Therefore, this case has the potential to be illustrative of the current state of collaboration among coaches and sport scientists in the most promising circumstances. The case study incorporated two stages of data collection (approved by a Research Ethics Board) in a sequential process.

The first stage of the case study involved the creation, testing and administration of an internet-based questionnaire. The questionnaire was designed to provide an initial assessment of coaches' interest in sport science or sport scientists and whether there is interaction or collaboration between the two. Each coach was presented with an information

letter inviting him or her to complete the questionnaire. If he/she completed the questionnaire, then he/she was asked to participate in the second stage, a 20 minute personal interview to further discuss the questions. Depending upon the answers to those questions, the interviews would take on a different form, and a structured interview guide for the second phase was thereby developed. The personal interviews were conducted by a member of the research team trained in interview techniques, audio taped and transcribed verbatim by the researchers within a one-week period.

PARTICIPANTS

The participants were 20 full-time head or assistant coaches (11 male and 9 female) of athletes involved in competitive university sport (in 11 different sports including basketball, volleyball, ice hockey, swimming, tennis, field hockey, rugby, soccer, track and field, football and wrestling). The coaches were staff members in an academic unit at a research-intensive university. All of the coaches had university degrees, and six had Master's degrees. The sample included 14 head and 6 assistant coaches. All of the head coaches had over five years of high-performance experience. All of the respondents had offices located on a university campus in close proximity to sport scientists.

THE QUESTIONNAIRE

During the creation of the questionnaire, it was agreed to use the phrase "new idea" to refer to the acquisition of knowledge in an attempt to make the questions as relevant to the coaches as possible. The questionnaire was designed to ask about the types of new ideas these coaches are looking for, and what sources they consult. The questionnaire included 18 questions, including 6 questions related to the coaches' context (sport, education, experience). Two questions (see Tables 1 and 2) were related to the types of knowledge coaches seek, two questions were related to how often coaches look for information, and the remainder of the questions were focused on the sources of information that coaches would access. The research team conducted preliminary trials of the questionnaire with a small sample of volunteers who had coaching experience, which resulted in revisions to improve question clarity. The questionnaire took about 15 minutes to complete. The specific item content and response patterns are presented in the results.

PROCEDURES

The coaches were sent a link by e-mail to the web-based questionnaire. In the e-mail, coaches were informed about the nature of the present study and were asked to imply their consent to participate by completing the on-line research survey.

RESULTS

The survey software tracks the responses and provides a frequency distribution for each question. Descriptive data regarding the frequencies of specific responses were examined to give an idea of the most common responses. No additional analyses were conducted on these data due to the small size of the sample.

In the first question, a forced ranking method was used to have the coaches rank eight areas in which they are looking for new ideas (see Table 1). Tactical / strategy was ranked first by 9 of the coaches, and 12 ranked individual skill development second. Injury prevention and recovery, and nutrition, were ranked the lowest.

Table 1. Question 1: In which of the following areas of your sport do you think coaches are looking for new ideas? Rank each of the following from Most Likely (ML) to Least Likely (LL) (each point on the rating scale can be used only once).

Item	ML							$\mathbf{L}\mathbf{L}$
Tactical / strategy	9	4	1	2	0	2	1	0
Individual skill development	0	12	3	2	0	2	1	0
Mental training and preparation	6	1	4	0	0	2	1	0
Team practice drills	4	0	6	4	1	0	2	2
Fitness / conditioning	1	1	3	4	6	2	2	0
Strength training	0	2	1	5	2	6	1	2
Nutrition	0	0	0	2	3	5	5	5
Injury prevention and recovery	0	0	2	1	1	2	6	7

Table 2. Question 2: In what area(s) of your sport do you believe sport research is contributing new ideas?

Area	Yes,	Likely	Unsure	Unlikely	Definitely
I	Definitely	y			Not
Mental training and preparation	15	4	1	0	0
Strength	12	7	1	0	0
Injury prevention and recovery	12	6	2	0	0
Fitness / conditioning	13	4	2	1	0
Nutrition	9	7	3	0	1
Individual skill development technique	s 5	3	6	5	0
Tactical / strategy	2	4	4	8	1
Team practice drills	2	2	7	6	1

The coaches were then asked whether they agreed that sport research is contributing new ideas that could be used by coaches in their sport, and 17 responded "Yes" and three responded "Not sure". The next question (see Table 2) used the same areas as Table 1 and asked the coaches to indicate in which of these areas they believe sport research is contributing new ideas. The majority of coaches responded that sport science is definitely contributing new ideas in mental training and preparation, strength, injury prevention and recovery and fitness / conditioning. By comparison, only 2 coaches replied that sport science is contributing new ideas in team practice drills or tactical / strategy areas.

The coaches were then asked about the sources they would consult when seeking new ideas (see Table 3). The most frequently chosen sources for these coaches were clinics and / or seminars and other coaches. Sport science researchers and peer-reviewed articles were rated near last, but on-line discussions were the least likely source to be sought out. This finding was reinforced by the results of a similar question that asked the coaches to pick one from a set of five sources, with 11 of the coaches choosing seminar / clinic or presentation as their first choice. The second choice, endorsed by four coaches, was "Through another coach or trainer".

Table 3. Question 3: How likely is it that coaches in your sport would consult the following sources when seeking new ideas? Each point on the rating scale can be used only once.

Item	ML								$\mathbf{L}\mathbf{L}$
Clinics and / or seminars	7	5	6	0	0	1	0	0	0
Other coaches	6	7	3	2	2	0	0	0	0
Videos	1	3	5	5	4	0	2	0	0
Watching elite competition									
live or on TV	2	5	3	2	2	1	2	2	1
Books / magazines	2	0	2	8	2	3	1	2	0
Sport science researchers /									
academics	1	0	0	2	4	4	2	6	1
Published peer-reviewed									
articles in academic journals	0	0	1	1	2	6	5	1	4
Trainers	0	0	0	0	4	4	4	3	3
On-line discussions	0	0	0	0	0	1	4	5	10

Coaches were asked about the organizations that are potential sources of new ideas, and the first choice (see Table 4) was "Coaching clinics / seminars" with 11 of the 20 coaches ranking them as an excellent source. SportDiscus (http://www.sirc.ca/products/ sportdiscus.cfm), which is an on-line source of sport science information and self-proclaimed as "the world's leading database in sport, health, fitness and sports medicine", ranked the lowest of the listed potential sources of sport research information.

Table 4. Each of the following organizations is a potential source of new ideas for coaches in your sport. Please rate the following as a source of sport research for coaches in your sport.

Name of Organization	Excellent	Good	Fair	Poor	No Idea
Coaching clinics / seminars	11	5	3	0	1
National sport organizations	3	7	6	2	2
Coaches Assoc. of Canada	3	7	5	3	2
Individual sport's coaching assoc.	3	5	6	4	1
University academic departments	3	4	7	5	1
Provincial sport organizations	1	4	11	3	1
High performance centres	3	5	5	4	3
Sport science / research councils	0	3	6	3	8
Sport Canada	0	4	2	8	6
SportDiscus	1	3	1	2	12

The coaches were presented with six different statements (see Table 5) relative to sport research and access to researchers. While the coaches agree that sport research is being done, they also agree that the research is not easily accessible and disagree that coaches have access to sport researchers when trying to solve coaching problems.

When asked how often coaches look for new ideas, 11 said they look once or twice a year and 8 responded that they look once a month, or more frequently; with 15 of 20 coaches saying coaches are using new ideas either much or slightly more than they have in the past.

	Agree	Agree	Disagree	Disagree
	Strongly	Somewhat	Somewhat	Strongly
There is no sport research being				
conducted in my sport specifically	1	3	8	6
The research is not presented in formats				
that can be used easily by coaches	5	9	3	1
The research being done is not				
relevant to the questions that athletes				
and coaches in my sport have	3	3	10	3
The research being done is not				
easily accessible to coaches	6	10	3	0
Coaches in my sport have access				
to sport researchers and sport				
scientists when trying to solve				
coaching problems	2	5	10	3
Coaches regularly utilize the				
services of sport science researchers				
and scientists with their athletes	4	4	3	7

Table 5. For each of the following statements use the scale to indicate whether you agree.

DISCUSSION OF STAGE ONE

The coaches believed sport science research is being done in their sport, and are looking for new ideas several times a year. These results indicate a relatively strong demand for the types of information that sport science can provide. The coaches prioritized the need for new ideas in the area of tactical / strategy ahead of areas such as strength training, fitness and mental preparation, but believed that research on tactical / strategy and team practice drills were the least likely topics for sport research to be contributing new ideas. The findings indicate these coaches believe a gap exists between the knowledge coaches are seeking and the knowledge they believe is being generated by the sport scientists. Based on these data, we cannot determine whether this gap is real or perceived.

Clinics and seminars, and other coaches, were the most likely sources to be consulted when coaches were looking for new ideas which is consistent with Irwin et al. [11] and Cushion et al. [10]. One possible reason for coaches seeking knowledge from other coaches might be that they do not believe the information they most want, tactical / strategic, is available from other sources, particularly sport science. However, the predominance of clinics and seminars as a source of new ideas for these coaches may show that experienced coaches, such as those at universities, may be close to the top of the knowledge pyramid so they have to go outside the coach-to-coach circle for new information. So, in some circumstances, they appear to desire some mediation by clinic presenters.

Books, videos and watching elite competition were also used, but none of the coaches indicated they would get new sport research ideas from the original full text of an academic research journal. Given the significant resources available to coaches through SportDiscus, the indication in these data that the coaches have almost no knowledge about SportDiscus was surprising. Based on the results presented in Table 5, there is evidence that coaches have difficulty accessing and using the research in the formats currently provided, suggesting another reason why they do not seek out sport science as an information source.

These results confirmed that coaches are frequently looking for new ideas in a variety of areas, and acquire those ideas from a range of sources that do not typically include sport scientists or their direct research products. To gain a more detailed description of the types of new ideas that coaches are accessing, and how they acquire the new ideas, the next stage comprised of personal interviews was conducted.

PERSONAL INTERVIEWS

PARTICIPANTS

A total of 17 coaches (9 male and 8 female) agreed to be interviewed in person by one member of the research team. Fourteen were full-time head coaches in charge of a Canadian Interuniversity Sport (CIS) program and three were full-time assistant coaches. All names and references to specific sports are removed to protect the identities of the respondents. The quotes are otherwise provided verbatim to retain the actual content of the response.

INTERVIEW GUIDE

After the questionnaire data were analyzed, a structured interview guide was designed to follow up on very specific areas that emerged from the results of the questionnaire. For example, the questionnaire data informed us that coaches are looking for new ideas and in which general areas, but we were interested in more detail. Toward this end, we designed a structured question asking the coaches for a specific example of a new idea they had recently implemented and where the idea came from. Follow-up questions included the coaches' willingness to share knowledge with other coaches, and their reaction to a prepared written statement about sport science. The final question in the interview provided the coach with an opportunity to make a recommendation as to how the transfer of sport research to coaches might be improved. The structured interview guide is included in Appendix A.

DATA ANALYSIS

The structure of the interview guide provided the preliminary structure for the qualitative data analysis. Analysis of the interview data was conducted by the lead researcher using a two-step process. First, the audio tapes of the interviews were listened to twice; once prior to transcribing, and once during the transcribing process. Second, the transcriptions were read and since the interviews were structured, the cumulative responses to each interview question were compiled and summarized. As the data were essentially narrative and descriptive, we organized the results by question and we looked for consistency or variance in the responses, the central point being to determine whether the coaches tended to agree or disagree on the various questions. As analysis proceeded, we highlighted within the transcripts all of the comments that related directly to the structure of the interviews. We then reviewed the non-highlighted areas to search for additional or unexpected themes that emerged inductively across the responses. This process combined a deductive process, using the structure of the interview guide as a guiding framework, with an inductive process that involved a search for other themes that emerged from the data.

As a check on the accuracy of the analysis, a second reviewer reviewed the transcripts and analysis. As a final check on our findings, we presented our results to the coaches that participated in the study to determine whether our interpretation of the data they provided was accurate. Their response to the presentation was confirmatory and increases our confidence in our findings. Consistent with the recommendations of Sparkes [19], quotations from the participants are presented in the results to represent the participants' views and to allow readers to judge for themselves the meaning of the data and the authors' conclusions.

RESULTS

NEW IDEAS

All of the respondents gave examples of new ideas they had recently implemented. The new ideas that were given by the coaches covered six of the eight areas that were addressed in the questionnaire (see Table 1). Table 6 provides examples of quotes within each area.

The coaches' new ideas cover a range of sport science areas, including physiology, psychology, biomechanics, and tactics. An important result for this study was the extent to which the ideas could be classified in one of two ways: (a) new ideas originating from sport science, or (b) old ideas new to the coach. For example, the comment about the research related to spiking is obviously a new idea coming directly from research whereas the use of a strength and conditioning coach is a new idea for that coach but not a new idea in high performance sport.

Area	Coaches' New Idea
Tactical / strategy	<i>"The newest idea. I guess just using a more of a game based approach."</i>
Team practice drills	"We used a new drill this year that we had never used before. I would say every year that we probably have some new things, mostly technical."
Individual skill development	"Some of the things related to spiking. Technical performance." "Something that we've learned through some of the research that he's doing in the area about the contact of the hand on the ball."
	"On a technical basis we made a change on our rooking technique lately."
Fitness / conditioning	"Actually, the idea of doing more agility work in incorporation with the warm-ups agility based warm ups as opposed to the static stretching."
	"A more formalized warm-up including dynamic stretching."
Strength training	"Functional strength and conditioning training without weights."
	"I guess probably the addition of a strength and conditioning coach."
Mental training and preparation	<i>"I've been combining a lot of emotional intervention with performance."</i>
	"Probably one of the things we did was a sort of a combined mental – training goal setting session that we would do every morning before a competition."
	"I think we're using more computer-based programs and I've been getting more involved with that computer access to getting information on team building."

Table 6. Examples of Coaches' New Ideas Grouped by Area of Knowledge

SOURCE OF THE IDEAS

These results include data about the source of the new idea and how the coach accessed the source. In general, two categories of responses emerged. In the first category were situations where a coach was attending a clinic or seminar and found a new idea. In the second category, the coach had some problem or issue and proactively sought information either by speaking to or observing other coaches.

For some coaches (tennis, rugby, and hockey), the ideas originated from the National Sport Organization (the original source prior to the NSO is unknown) and were delivered to the coaches by national team coaches or high-performance directors in clinics or seminars. In these situations, the coaches may not have been looking to address specific issues but were involved in a mediated learning situation and received some information that they believed would be useful for their athletes. Two examples are provided below:

"Initially from Tennis Canada. And Tennis Canada comes to our club 3-4 times per year plus they hold a provincial conference basically just for coaches, highperformance coaches; so initially they came out and introduced it and they have been continually feeding us information on it."

"Hockey Canada put on an international hockey coaches symposium. There were speakers from all over the world and they talked on a variety of topics related to the sport of hockey and sport in general."

However, in the majority of the situations, the coaches seemed to use unmediated learning approaches by proactively searching for ideas that could improve their programs. In some cases, the coaches observed professional teams as the following quotations illustrate:

"Middlesbrough Soccer club, it is a professional soccer club in England. We observed it. We had a young group that actually got an opportunity to work through all the stretching. We actually taped the stretching routine and we have implemented it with most of our teams."

"Just observation of other teams practicing when they come in. For this year it was the American Hockey League. In other cases I would go down and watch NHL teams practice when they would come into town to get different drill ideas."

In other cases, coaches told us they found their own information in books, or on-line. There were a few coaches who also mentioned communicating with sport psychology or strength and conditioning consultants to get new ideas. There was only one coach who had a direct interface with sport scientists or academic publications. The following quotations represent how some of the coaches felt about their access to sport scientists.

"I would really like to have an individual sport psychologist work with our program. ... with their expertise and you can sort of pick their brain and have a conversation with them just all the much easier and stronger it is for you then generate ideas and take from them."

"... having a relationship with a sport scientist well enough to say I have this problem, can you help me? And so that on going relationships, the sport scientist becoming

visible and accessible by putting themselves out there for conferences and working with teams and so forth."

The data show that knowledge is being acquired from a variety of sources by the coach as the end user, and while most of the coaches have indicated they do not work directly with sport scientists (despite their physical proximity in this case), there are indications that coaches would like to receive help from a sport scientist.

COACHES' THOUGHTS ON KNOWLEDGE TRANSFER

The following results are a combined summary of the coaches' comments to the questions "Now that you have this information, with whom would you share or did you share that new information?" and "What do you believe needs to be done to improve the transfer of sport research information to coaches?" In general, the following quotation is an excellent representation of the feelings of the coaches regarding knowledge that is available and the coaches' role in finding whatever is specific to their sport:

".. over the last five to ten years, ... there is so much new information being discovered .. a little bit of difference between different sports, in terms of different ideas and philosophies or whether its just different results. For me I try to find whatever is most specific to my sport and what seems to be new and cutting edge and has proven results."

The results from the structured interview questions were further separated into three themes that emerged inductively: applicability of sport science knowledge; dissemination of knowledge; and time, which emerged as a dominant theme from the coaches' responses.

Applicability of Sport Science Knowledge. One coach commented on the motivation for seeking new ideas. "I think that for the most part coaches are interested in anything that will help them win." Another coach provided some clarity on this motivation for seeking new ideas:

"I think coaches have to perceive a need. ... coach will diagnose a need and then look for a cure. I don't think they ... shop around just for miscellaneous things that aren't within their immediate focus... If it doesn't solve the problem I have today I'm not too interested in it today, but I'll file it away and I may come across it again later."

This quotation indicates the existence of a problem-driven knowledge acquisition process, and the issue of when the new ideas are needed. Given that neither the coach nor the sport scientist can possibly predict what problems will arise or what solutions will be sought (as evidenced by the wide range of new ideas in Table 6), the ability of sport science to deliver data derived solutions to these immediate problems is not feasible. Therefore the coaches' knowledge acquisition process often relies on current knowledge and the coach contacts a colleague or a sport scientist for immediate advice.

It is important to emphasize that all of the coaches believed there is a lot of applicable knowledge being generated that they are not receiving. However, the specificity of knowledge in the transfer process is important, as articulated by two coaches in the following responses:

"Really making it specific. I think it is up to the NSOs (National Sport Organizations)

to package it in such a way that it can be relayed ... I just think the user-friendly terms is the biggest thing. Making the public aware that these sport science journals exist and that they can be useful."

"... they are more interested in focusing on their sport so they will rarely look at or will rarely go out of their way to find what I would call esoterical articles about psychology or nutrition in general but if it is presented exactly in-line with what they are doing then I think they would be interested in it."

These responses raise the issue of the need for specificity of knowledge if it is to be applied, but also the need for user-friendliness in the knowledge translation process. One coach felt that the research questions taken up by the sport scientists need to be driven by applied questions that coaches have:

"If there was more applied research driven by questions that coaches have it probably would have more appeal to us to be seeking that information out."

Another coach felt that the information could be made applicable by delivering the ideas to the coaches at a clinic:

"I think it needs to be made more applicable. For example, if you write an article in a journal, in a sport psych journal, I don't believe coaches for the most part read sport psych journals. But if a coach goes to a basketball clinic and there is a sport psychologist as part of that clinic giving his or her research, then I think coaches would be interested in that."

Dissemination of knowledge. As one would expect from the literature, which has repeatedly shown that coaches learn from other coaches, these coaches indicated their willingness to share (transfer) knowledge. This group of coaches primarily shared with other coaches in their program, or coaches at the university. These two short quotes exemplify the responses of the group:

"[I share with] other coaches. My friends that coach. Probably the basketball community in general."

"The assistant coaches, all the people that are around here, that's all. I just shared it with our team."

However, they do seem willing to share their new ideas outside of their own program or to engage in a sharing exchange with other coaches:

"I occasionally do mentoring and conferences or working with other coaches and of course athletes. I just did a conference in B.C. last weekend."

"I might put that in as a drill that the other coaches could look at and potentially use. ... and that would be probably the extent of it, other than communicating that possibly to minor hockey coaches that I deal with."

Their opportunity to share information was primarily related to the head coaching role of most of them and their focus was on their own program rather than the sport more broadly. There was no indication that sharing information with other coaches would be a problem. These results are in agreement with the literature that sharing among coaches is a common means of knowledge transfer, but is the dissemination of knowledge by sport scientists effective? Most of the coaches commented on the need to improve dissemination of the knowledge generated by sport scientists and the failure of academic publications as a means to contribute to coaches' knowledge:

"The biggest difficulty is I won't go through a technical manuscript because there is too much other information in there that isn't really applicable to what I need to do."

"I don't think that the academic writing is an effective tool because ... I think there are many coaches who are not academic in any way and so if you package it as an academic paper it's not interesting to 95% of the coaching staff."

"... it becomes a problem because of the language used by researchers when they are publishing journals so when the general coach who doesn't have a sport science background I think they have trouble reading it sometimes ... They don't understand it."

"You've got this research right? And it's applicable. Then... you publish it in a research magazine or something like that, you don't make that available in a clinic. You know, that's where it stays, it stays in the publication."

"In order to get stuff published ... it has to be done in a particular manner and that needs to be respected. But ... it would be nice if someone could more or less ferret out all of the information and give coaches a Cole's notes of stuff that they need to know. I mean, they can certainly refer them to the journals and the articles if they really want to get the full meal deal ... it would be nice if there was a way to quicken that process up."

Time. While time was not an anticipated theme in this research, it emerged from our analysis process. Time was, in our view, a strong theme and was mentioned by six coaches. Three verbatim responses are provided as examples:

"... that the coaches are on the court doesn't leave a lot of freedom to go out and do a lot of things outside of that. ... the information is coming to us; its whether the coaches want to take the time to learn it or use it, but it is there. But I can't speak for other sports."

"I'm not sure about the packaging and deliver to them, although that probably is, it just sounds so passive and I don't think it's a function of people not wanting to go out and seek out the information; I think it is the state of over-workedness state of coaching and that there just isn't... I always set a goal every year I'm going to spend an afternoon a week in the library and just read and that never happens – it's just impossible to find that time." "I find it's difficult for me to find the time. Now my situation may be different because I have young children so I spend so much time here that when I go home I don't take the time to read magazines which I feel badly about. I feel like I should be reading more."

When individuals mention time as a barrier, it is possible that higher priorities consume their time. We must be cognizant of the possibility that seeking out new ideas, or sport scientists, is not a high priority for these coaches in comparison to other priorities. Followup research is required to provide some context to this theme, and to understand if time is a barrier that can be overcome.

GENERAL DISCUSSION

These results contribute empirical evidence that high-performance coaches believe sport science is being conducted that can benefit their sports, and in this regard are in agreement with the recent findings of Williams and Kendall [21]. This belief is foundational to the transfer of knowledge from sport scientists to high-performance coaches. Apparently, though, the coaches in this study believe their main interests (in areas such as tactics and strategies) are not being addressed by the sport science being conducted.

The coaches had no difficulty articulating new ideas they had recently incorporated. The ideas varied, representing a wide range of areas of sport science from the addition of practice drills to the incorporation of leading edge, scientifically based mental training techniques. The examples presented here provide some empirical evidence of the specific differences that are referred to by Werthner and Trudel [17], "Rather than continuing to search for differences between coaching contexts, it is becoming evident that it is more important to begin to understand the similarities and differences between coaches in a similar coaching context" (p. 208). Gilbert et al. [6] seem to agree with Werthner and Trudel stating, "It appears that coach development models need to be coaching context specific." (p. 75). The range of new ideas the coaches are interested in (which would have to be included in a coach development model) is important to understand, and we now have empirical evidence that the coaches' interests, even when the coaches are located in a similar high performance context, vary widely. Such diverse interests create course content or curriculum design challenges for sport scientists and other knowledge providers that wish to assist highperformance coaches in finding and incorporating new ideas. If our finding, which is consistent with the findings of Saury and Durand [8], is indicative of the needs of highperformance coaches, then an unmediated coach-driven knowledge transfer strategy that expects, prepares and empowers the coach to initiate the process might be the preferred solution.

While we were specifically looking for coaches' use of new ideas that come directly from sport scientists, minimal evidence of this emerged from our respondents. We did uncover evidence that some coaches are able to access sport scientists to help them generate new ideas, and further study is needed to understand why some coaches exhibit this behaviour while others do not.

The results corroborate earlier research findings that coaches are using unmediated learning strategies by borrowing ideas from other coaches or through observation [11, 12, 17]. Although one might hypothesize that coaches would be reluctant to share their information due to the competitive nature of sport as suggested by Gilbert and Trudel [12], coaches consistently commented that they get most of their knowledge from other coaches. Given the ubiquitous existence of this process, it remains unclear how, for the majority of

coaches, new ideas enter the coach-to-coach loop. Whether coaches simply borrow these ideas by observing, by verbal exchanges, or through mentoring is not understood from these data. However, the potential exists for passing on, and repeating, harmful or ineffective practices if knowledge is transferred from coach to coach without the benefit of scientific testing or other critical consideration of the ideas. Cushion et al. [20] articulated this concern citing Cushion [10]: "Mentoring in its current form, however, appears largely unstructured, informal, and uneven in terms of quality and outcome, uncritical in style, and, from the evidence, serves to reproduce the existing culture, power relations, and importantly, existing coaching practice." (p. 223). Cushion seems to be calling for the inclusion of critical inquiry in the information which is passed on through mentorship, and critical inquiry is an appropriate role for sport scientists to play in the transfer and application of knowledge.

The coaches did express a desire to work directly with sport scientists, but the coaches' desire to have immediate answers to their questions is problematic in the context of engaging in the inevitably long-term and rigorous research process of a sport scientist. While the coach is interested in immediate improvements in athlete performance, the sport scientist will be engaged in a long-term research program, probably struggling to obtain funding to support the research, and producing publishable manuscripts that will be accepted in peer-reviewed publications (academic journals). Additionally, sport scientists will favour scientific methods that require sound testing of ideas which takes time and corroboration, and are, generally, unwilling to make strong recommendations on the basis of only one or a few completed studies.

Our findings did suggest that mediated learning at clinics and seminars is a common way for these coaches to get new ideas in addition to learning from other coaches. Our data did not provide an answer as to whether the presenters were coaches or sport scientists, but we suspect that for sport scientists, consultation with coaches, and presentations at coaching conferences, are likely lower priorities on the list of dissemination strategies that sport scientists in academic settings will use. Sport scientists are likely to prefer presentations at academic conferences to presentations at coaching seminars when choosing their venues for knowledge dissemination.

The coaches may be able to get the sport science information they need from sources such as sport science journals, but it was clear that the coaches in this study do not read academic publications, do not find them "user friendly", and as a result may have difficulty accessing sport science knowledge. Our findings support those of Irwin et al. [11] and Williams and Kendall [21] who found that coaches felt this type of information was too specialized and not practical and therefore not a preferred source of knowledge. SportDiscus is one resource specifically designed to provide access to sport science information and facilitate the knowledge transfer process, but it is clear from this group of coaches that SportDiscus is not fulfilling, or even contributing to, their sport science knowledge needs.

Limited time was also a strong theme in the results, and is likely associated with the coaches' expressed desire to have the information easy to access and directly applicable to their coaching practice. Time is always a function of setting priorities, and if a motivated coach sees an urgent problem to be addressed, he/she will make the time to solve the problem by setting aside other tasks. This may explain the behaviour of borrowing from other coaches as the borrower may be able to get information quickly and efficiently from a source they have access to and feel they can trust. It would also explain the desire to have access to a sport scientist that the coach can consult directly for advice without taking the time to read and comprehend written information. Furthermore, coaches clearly indicated that they did not think that sport science was available in the areas of strategy and tactics, for example.

Obviously, if they do not think information is likely to be forthcoming from a particular source, they will be unlikely to even attempt to access that source, particularly if they find the access procedures cumbersome and frustrating. It can be concluded that, as suggested by Irwin et al. [11], the information-seeking behaviour will be related to the information content and beliefs about the most expedient way to achieve the needed information.

LIMITATIONS

As this was a single case study, it only included one or two coaches from each sport, and we could not conduct a meaningful between-sport analysis to determine whether coaches in different sports acquire knowledge in different ways. The coaches in our case are in a relatively unique physical location that would facilitate interaction between sport scientists and coaches, and further study is needed to ask these questions of a much broader and more diverse group of coaches that may not have such convenient access to sport scientists. With the limited sample size, there was also no way to determine the effect that factors such as education or experience might have had in their knowledge acquisition process.

CONCLUSION

How can the knowledge transfer process between coaches and sport scientists be improved? It does appear, based on these data, that a coach's motivation (based on their desire to find new ideas and the frequency with which they say they look) could be an important factor in knowledge acquisition and transfer. It was suggested coaches and athletes are motivated to win and will utilize unmediated learning strategies to look for new ideas if, at any given moment, they believe the new ideas will solve a problem or give them a competitive advantage. If this is true, the motivated coach will be more likely to close the knowledge gap, including the possibility of proactively engaging a sport scientist. Further study is required to understand this factor.

A second factor might be the need to translate the sport science information for the coach and make it easier for the coach to understand and apply. Gould et al. [1] and Salmela [3] say coaches should be mentored by other coaches. The results of this study suggest the need for mentorship by sport scientists as well as mentorship by other coaches.

Oral communication and observation were preferred means of knowledge acquisition for the coaches. Formats such as academic journals, books, newsletters or on-line resources were consistently secondary choices. Whereas this is not surprising given the research cited previously [21], we believe this study contributes empirical evidence to suggest a coaches' preference for an oral style of knowledge transfer process. Oral knowledge transfer is difficult to document or track, and the academic evaluation system within which most sport scientists operate rewards written publication in peer reviewed journals over oral contributions made at conferences or seminars. Whereas sport scientists may also contribute to coaches knowledge through one-on-one personal interactions, it is unlikely such contributions would be recognized at all in the academic evaluation system. There is convincing evidence, even in this small study, that an unmediated, coach-driven knowledge acquisition system can be effective but further study is required to determine how this process could be utilized on a more formal basis.

The use of the findings from a single case to develop a model for knowledge transfer between sport scientists and coaches is premature, but our findings suggest the following factors should be considered in future research in the development of such a model:

- Coaches are highly motivated to improve and they believe that sport science knowledge can provide the knowledge they need.
- The needs are diverse, unanticipated and often urgent such that the coach must drive the knowledge transfer process.
- Urgent needs are best met by verbal communication with trusted, knowledgeable individuals who may be a mentor coach or colleague, but who could also be a sport scientist.
- Longer term and ongoing education can be delivered at clinics and seminars, but sport scientists must be engaged to present at these seminars for new knowledge to enter the coach-to-coach loop.
- Written information does not meet the needs of coaches because of the investment of time required; therefore direct and efficient knowledge transfer is critical.

The results add evidence to the findings of Williams and Kendall [21] that highperformance coaches are motivated to improve their programs and athletes, believe sport science can contribute to their programs, and actively pursue new ideas. Although the coaching context was the same for all of our coaches, both the ideas and the source of the ideas varied. Some coaches were able to get information from sport scientists, to bridge the gap, and many of them would like to work more closely with sport scientists. There is a need for a future study that will incorporate a larger and more diverse group of coaches to determine whether the variance within this context is due to sport-specific differences or some other factor. Further research will be essential to develop strategies to facilitate knowledge acquisition and knowledge transfer of sport science to coaches.

REFERENCES

- 1. Gould, D., Giannini, J., Krane, V. and Hodge, K., Educational Needs of U.S. National Team, Pan American and Olympic Coaches, *Journal of Teaching Physical Education*, 1990, 9, 332-344.
- 2. Bloom, G.A., Bush, N., Schinke, R.J. and Salmela, J.H., The Importance of Mentoring in the Development of Coaches and Athletes, *International Journal of Sport Psychology*, 1998, 29, 267-289.
- 3. Salmela, J., Learning from the Development of Expert Coaches, *Coaching and Sport Science Journal*, 1995, 2(2), 3-13.
- 4. Irwin, G., Hanton, S. and Kerwin, D., Reflective Practice and the Origins of Elite Coaching Knowledge, *Reflective Practice*, 2004, 5, 119-136.
- Côté, J., Salmela, J. H., Trudel, P., Baria, A. and Russell, S., The Coaching Model: A Grounded Assessment of Expert Gymnastic Coaches' Knowledge, *Journal of Sport and Exercise Psychology*, 1995, 17, (1) 1-17.
- 6. Gilbert, W., Côté, J. and Mallett, C., Developmental Paths and Activities of Successful Sport Coaches, *International Journal of Sports Science and Coaching*, 2006, 1(1), 69-76
- Rodgers, W., Reade, I. and Hall, C., Factors that Influence Coaches' Use of Sound Coaching Practices, International Journal of Sports Science and Coaching, 2007, Vol 2(2), 155-170.
- Saury, J. and Durand, M., Practical Knowledge in Expert Coaches: On-site Study of Coaching in Sailing, Research Quarterly for Exercise and Sport, 1998, 69(3), 254-266.
- 9. Jones, R.L., Armour, K.M. and Potrac, P., Constructing Expert Knowledge: A Case Study of a Top-Level Professional Soccer Coach, *Sport, Education and Society*, 2003, 8, 213-229.
- 10. Cushion, C.J., Armour, K.M. and Jones, R.L., Coach Education and Continuing Professional Development: Experience and Learning to Coach, *Quest*, 2003, 55, 215-230.
- Irwin, G., Hanton, S. and Kerwin, D., The Conceptual Process of Skill Progression Development in Artistic Gymnastics, *Journal of Sports Sciences*, October 2005; 23(10), 1089-1099.
- 12. Gilbert, W. and Trudel, P., Learning to Coach Through Experience: Conditions that Influence Reflection, *The Physical Educator*, 2005, 62(1), 32-43.

- 13. Cassidy, T., Jones, R.L., and Portac, P., Understanding Sports Coaching: The Social, Cultural and Pedagogical Foundations of Coaching Practice, 2004, Routledge, London.
- 14. Gilbert, W. and Trudel, P., Learning to Coach Through Experience: Reflection in Model Youth Sport Coaches, *Journal of Teaching in Physical Education*, 2001, 21, 16-34.
- 15. Gilbert, W. and Trudel, P., An Evaluation Strategy for Coach Education Programs, *Journal of Sport Behaviour*, 1999, 22(2), 235-250.
- 16. Malete, L. and Feltz, D.L., The Effect of a Coaching Education Program on Coaching Efficacy, *The Sport Psychologist*, 2000, 14, 410-417.
- 17. Werthner, P. and Trudel, P., A New Theoretical Perspective for Understanding How Coaches Learn to Coach, *The Sport Psychologist*, 2006, 20, 196-212.
- 18. Yin, R. K., Case Study Research: Design and Methods, 3rd edn., Sage Publications, Thousand Oaks, CA, 2003.
- 19. Sparkes, A.C., *Telling Tales in Sport and Physical Activity: A Qualitative Journey*, Human Kinetics, Champaign, IL, 2002.
- Cushion, C.J., Armour, K.M. and Jones, R.L., Locating the Coaching Process in Practice: Models for and of Coaching, *Physical Education and Sport Pedagogy*, 2006, 11(1), 83-99.
- 21. Williams, S. J. and Kendall, L., Perceptions of Elite Coaches and Sports Scientists of the Research Needs for Elite Coaching Practice, *Journal of Sports Sciences*, 2007, 25(14), 1577-1586.
- 22. Coaching Association of Canada, National Coaching Certification Program, Http://www.coach.ca

APPENDIX A

STRUCTURED INTERVIEW GUIDE Name: Date of Interview: Sport: Tape and Interview Number:

- Do agree to participate in this research study?
- Do agree to this telephone conversation being recorded?
- Were any of the questions confusing or difficult to answer in the survey, do you recall having any problems with the ease of use or anything like that?
- And did you encounter any problems with the email distribution or on-line submission?
- Now getting into some specifics, we want to know a little bit more about your coaching practices. So, what was the newest idea that you incorporated into your coaching practices?
- Can you recall where that concept or that new idea came from?
- How did you use that information?
- Now that you have this information, with whom would you share or did you share that new information?
- Based on the survey responses to date, a generalization of the current situation that exists with sport science research and high performance is as follows:

High-performance coaches believe that sport science is contributing to the creation of new ideas in sport. Coaches are receptive to the possibility of using these new ideas in practice. However, coaches will rarely seek out published sport research. Instead, in order for coaches to access the information, it must be packaged and presented to the coach.

- Do you believe this statement is accurate?
- So, given that statement, what do you believe needs to be done to improve the transfer of sport research information to coaches?
- Did you have any other questions?

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