

# **Coach-Athlete Interaction during Elite Archery Competitions: An Application of Methodological Frameworks Used in Ergonomics Research to Sport Psychology**

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This study analyzed the temporal and contextual organization of coach-athlete interactions in elite archery competitions. In light of the course of action theoretical framework (Theureau, 1992) from ergonomics research, action was conceived as situated (i.e., closely linked to ecological constraints) and was studied at the level at which it is significant for the actor. One expert archery coach and four elite athletes were observed and videotaped during two competitions. The coach's and athletes' verbalizations were also recorded during self-confrontation interviews immediately after each competition. Data processing consisted of: (a) transcribing the coach's and athletes' actions, communication, and self-confrontation data; (b) decomposing action into elementary units of meaning; (c) identifying coherence and similarities of sequences; and (d) examining the coordination of the courses of action of the coach and athlete. The coach's course of action was characterized by respect for the athletes' autonomy, analysis of performance decrements, and emergency interventions. The athletes' courses of action were characterized by autonomy and help-seeking. The coach's and athletes' collective courses of action showed that cooperation within the dyad was either immediate, due to shared perceptions, or was constructed through negotiation. This study outlines the situated and constructed nature of coach-athlete cooperation, and suggests the value of such frameworks from ergonomics, for coaching, and counselling.

In recent years, studies on coach-athlete relationships have taken a variety of approaches using: (a) questionnaires to examine coaches' leadership behaviors (Chelladurai & Saleh, 1980), (b) systematic observation to examine coaches' instructional behaviors (Dodge & Hastie, 1993), and (c) in-depth interviews to investigate the knowledge and development of expert coaches (Côté, Salmela, Trudel, Baria, & Russell, 1995). In line with this third approach, some studies have examined both coaches' and athletes' perceptions regarding their effective interactions in different sports (d'Arripe-Longueville & Fournier, 1998; d'Arripe-Longueville, Fournier, & Dubois, 1998; Côté & Dowd, 1996). For instance, d'Arripe-Longueville and Fournier identified the French elite male archery system as a collective work characterized by deliberate cooperation. This cooperation has been described as coordinated effort between the respective strategies of coaches and athletes, based on a shared conception of archery coaching which emphasized mental skills rather than physical technique. In the d'Arripe-Longueville and Fournier study, in-depth interviews enabled the underlying factors of the coach-athlete relationship in typical training and competition situations to be identified. However, the methodology used was not appropriate for a detailed description of the coordination of the coach's and athletes' activities in specific competition settings.

Another recent line of research on coaching expertise corresponds to an ergonomic approach to sport training, defining a situated cognitive anthropology perspective (Saury, 1998; Saury & Durand, 1998; Saury, Durand, & Theureau, 1997; Sève & Durand, 1999). These studies take into consideration the implications of situated action (Lave, 1988; Suchman, 1987) and situated cognition (Kirshner & Whitson, 1997). In this approach, situated actions are defined as actions taken in the context of specific, concrete circumstances. Cognition is seen as indissociable

from action and experience, and closely linked to ecological constraints. This approach implies that cognition (or action) must be studied *in situ* and that the points of view of actors have to be considered. For example, in elite table tennis, Sève and Durand (1999) described the temporal and contextual organization of three expert coaches' activities in training sessions. They showed that the coaches' activities were not planned in advance. Their plans were viewed as a weak resource, insofar they must accommodate unforeseeable contingencies of particular situations.

Furthermore, in elite sailing, Saury et al. (1997) have initiated a line of research more specifically based on the semiological framework of the course of action (Theureau, 1992; Theureau & Filippi, in press) used in ergonomics research. The course of action constitutes a dynamic and autonomous entity including actions, communication, interpretations, focalizations, or feelings, that are meaningful for the actor. The *intrinsic organization* of the action (i.e., organization from the actor's point of view) is described and analyzed in relation to the overall extrinsic characteristics of the situation (Theureau, 1992; Theureau & Filippi, in press). The methodology permits a complete and detailed analysis of the actions and events that occur in particular work situations (e.g., metro traffic regulation, functioning of hospital departments). It includes videotaped recordings collected in real situations and self-confrontation interviews in which the actor is urged to recall and explain what was personally experienced during the action, when confronted with the video images (von Cranach & Harré, 1982). Studies making reference to this approach in expert coaching in sailing enabled the expert coach's and athletes' activities in competition and training settings to be analyzed in depth (Saury, 1998; Saury et al., 1997). For instance, Saury et al. demonstrated that the archetypal structures of the course of action of an expert coach during international competitions were indissociable from situational characteristics and coach-athlete relationships.

Within this framework, the analysis of the collective activity of individuals involved in work or sport situations implies particular methodological considerations. Therefore the *collective course of action* concept has been proposed by Theureau and Jeffroy (1994) to explain the coordination of different courses of action originating in individuals acting toward or with others. The theoretical stance used in this approach is partly based on symbolic interactionism theory (Mead, 1934), on ethnomethodology (Garfinkel, 1967), and on the distributed social cognition framework defined in cognitive anthropology (Hutchins, 1995). Interactionist research examining collective activities in work situations (e.g., Rogalski & Samuçay, 1993) has shown that to see the coordination of activities as a juxtaposition of actions is a reductionist point of view. In fact, a common goal is not entirely a priori given, but rather it is collectively constructed by the interaction between the protagonists. The distributed social cognition approach developed in cognitive anthropology by Hutchins (1995) has also emphasized the fact that communication within a group is more than a simple knowledge transfer process from one actor to another. Communication refers to the creation of new collective knowledge which is not necessarily entirely integrated by each member of the group.

The coordination between the team members comes up against mutual constraints, and does not follow a general procedure or pre-defined plan.

Despite interest in some of these studies, some authors (Theureau & Filippi, 1994; Suchman, 1993) have deplored that they only sketch the collective activity and neglect the individual dimension of work by focusing on communication situations. In contrast, reference to the collective course of action concept (Theureau & Jeffroy, 1994) allows one to focus both on individual activities and on the collective construction of a situation. In fact, the analysis of the collective course of action is carried out in two phases. First, the analysis describes the course of action of each actor involved in the situation and interacting with the other actors. Then, the analysis attempts to characterize the way in which the different courses of action simultaneously taking place, result (or not) in efficient, coordinated collective action. Inspired by the theoretical and methodological framework used in ergonomics research, the present study aimed to investigate the temporal and contextual organization of the coach's and athletes' interactions in specific archery competitive settings. Such an approach was seen as a useful complement to in-depth interviews which have enabled a wider description of the coach-athlete relationship (d'Arripe-Longueville & Fournier, 1998).

## METHOD

### *Participants*

One expert male archery coach and four elite male athletes from the French national team volunteered to participate in the study. The coach satisfied the Côté et al. (1995) criteria for expert coaches. Of the four archers, two were among the world's best eight archers, one being an Olympic title holder and European champion, the other an European champion and World medal holder, and the other two held national titles. To guarantee anonymity, a coding system was used to attribute quotations. A letter identified the participant as the coach (C), or as one of the four athletes (A1–4).

### *Data Collection*

Two types of data required by the course of action theory methodology were collected: (a) data observed and recorded during the competitive situations, and (b) data from verbalizations elicited during self-confrontation interviews.

*Data observed and recorded in competition situations.* Coach-athlete interactions were recorded during two competitions. The first one was an 8-hour international event and the second one a 2-day national competition which were thus important for the athletes. The first one had financial stakes and media coverage, and convened the eight world's best archers. The second competition was considered as a test-competition which preceded the selections for the 1998 European championships. For each competition, all coach-athlete communication was recorded, from the training that preceded the competition through the post-competitive phase. Coach-athlete interactions were entirely video recorded, except those

which occurred far from the target lane. Recording materials included an HF microphone worn by the coach, and an Hi8 video camera set up behind the firing line, where many coach-athlete interactions traditionally occur. These materials were not seen as a nuisance because they have been extensively used in previous training sessions, so that the participants were familiar with the equipment and interested in the results. During the competitions, the coach's microphone was concealed to ensure privacy. However the athletes knew that verbalizations were recorded and they agreed with that procedure. All the participants said that they ignored it very quickly, because they concentrated on the competition.

Two investigators were involved in the data collection process; both were familiar and comfortable with the participants, thanks to a previous qualitative study and regular consulting. The first researcher was responsible for filming, and the other researcher, equipped with headphones, was responsible for listening to coach-athlete communication and taking notes. The latter was taken to obtain information about other forms of data that were judged pertinent by the researchers, yet may not have been recorded. These notes also enabled the interactive situations between the coach and each athlete to be temporally and contextually identified and coded (e.g., 3:12 p.m., C-A2, 70m, wind on the left, second cassette). These codes facilitated the self-confrontation interview process which followed. Thus, data were recorded without interruption during 8 hrs of the first competition, and 14 hrs 30 min of the second competition, making a total of 22 hrs 30 min of data collection.

*Data from self-confrontation interviews.* The elicited commentaries were collected after each competition during self-confrontation interviews conducted with the coach and the four athletes. The self-confrontation interview is a method developed by von Cranach and Harré (1982) to assess ongoing cognitions. It consists of a procedure in which a person is confronted with his/her own activity in particular situations, as soon as possible after the event in question. During the interview, the person is asked to describe with precision that activity, according to his/her point of view. In the present study, such interviews took place in the two days which followed the first competition, and during the five days which followed the second competition. For this competition the delay was longer, insofar as the recorded data were more extensive, and because one of the four athletes could not earlier participate in the interview. We assume this did not affect the credibility of the results as we ensured that no particular archery event occurred between the competition and the athletes' interview (von Cranach & Harré, 1982; Theureau, 1992). Moreover, video recording and descriptive questions asked during the interview were powerful aids that helped the participant reconstruct his past experience in all its complexity (Theureau, 1992).

A number of particular interactive situations were selected for each participant's interview, for the following reasons. First, because of the burden of the interview process and the athletes' temporal constraints, self-confrontation with all video-recorded data was impossible in the short delay required by this method. Furthermore, such a confrontation would not have been productive, insofar as much of the data was irrelevant for coaching (e.g., recreational conversations between

the coach and other people, organizational tasks, and meals). Finally, for ethical reasons, athletes could not hear and see the private communication between their peers and the coach. Therefore, the following selection process was developed: (a) The researchers carefully examined all of the video recorded data; (b) all coach-athlete interactive situations, both focused (i.e., including communication) or not focused (i.e., without communication), were identified and coded, and compared to the field notes; and (c) at the beginning of the interview, each participant was asked with which interactive situations he would really like to be confronted.

The criteria for selection were the following: (a) The situation had to include coach-athlete focused or non-focused interactions; (b) the situation had to be particularly significant for the participant (e.g., with regard to the importance of events, or to particular emotions); and (c) agreement between coach, athlete, and researchers, or at least two of the three actors should be reached (Lincoln & Guba, 1985). Thus, 15 situations were selected, 7 situations, averaging 9 min each, concerned coach-athlete communication between two ends (i.e., a series of three to six arrows shot consecutively, the number depending on whether the event is short or long distance). Three situations, averaging 4 min each, concerned coach-athlete communication between two events. Five situations, averaging 3 min each, concerned sequences with non-focused interactions. During the interviews, the coach was confronted with the 15 situations, while each athlete was confronted with four, except A1, who was only concerned with three significant situations. To help the participant reconstruct and recontextualize the selected situations, the events that preceded or followed these situations were generally reviewed. Therefore, altogether, confrontational responses concerned the coach's course of action over a period of 115 min, while the athletes' self-confrontation interviews took an average period of 31 min. Each interview with the coach lasted between 3 and 4 hrs (including a break), while the interviews with the athletes averaged 2 hrs.

Prior to the interviews, informed consent was obtained from all participants. The same two researchers who collected the data were also involved in the interview process. Both researchers had experience with traditional qualitative research and interviewing techniques, and were specifically trained in self-confrontation interviews by two other researchers having extensive experience with this method. One researcher conducted the interview and asked each participant to describe, indicate, and comment on any elements of his course of action, including actions, communication, interpretations, focalizations, or feelings, that he considered significant (Theureau & Jeffroy, 1994; Theureau & Filippi, in press). Various techniques (Seidman, 1991) were used to assure the authenticity of the participants' responses. First, the questions asked about the participants' courses of action were made as precise as possible. Second, leading questions that might have influenced the direction of the responses were avoided. The role of the interviewer was to listen actively to each participant, to encourage him to describe his activity, and to avoid interpretations, generalizations, and self-analysis (von Cranach & Harré, 1982). The role of the second researcher was to manage the video equipment (e.g., pause, review, etc.), to check that all the selected situations had been

commented upon, and to supplement the first researcher, when necessary. The 10 interviews were video-recorded and a full verbatim transcription of each interview was made.

### *Data Analysis*

Data analysis was based on processing used in cognitive ergonomic research (Theureau, 1992; Theureau & Filippi, 1994; in press). The analysis focused first on individual courses of action, then on collective courses of action.

*Analysis of individual courses of action.* Individual courses of action were analyzed according to the following four steps: (a) verbatim transcription of coach's and athletes' actions, communication, and self-confrontation data; (b) identification of *elementary units of meaning* (EUMs) and construction of *condensed narratives* (Theureau, 1992); (c) examination of the types of coherence relationships among EUMs; and (d) identification of archetypal structures.

Verbatim transcription of coach's and athletes' actions, communication, and self-confrontation data resulted in 310 pages of transcripts. These transcripts were supplemented by field notes, and were then chronologically reorganized in tables including: (a) places, events, and meteorological conditions; (b) the coach's actions (i.e., non-verbal behavior); (c) coach-athlete communication; (d) athletes' actions; (e) coach's verbalizations during the self-confrontation interview; and (f) athletes' verbalizations during the self-confrontation interview. Secondly, EUMs were identified according to five predetermined categories (Theureau & Jeffroy, 1994, in press): (a) practical actions (what does the actor do?), (b) communication (what about [and with whom] does he talk?), (c) interpretations (what does he think?), (d) focalizations (on what does he concentrate?), and (e) feelings (what does he feel?). Responses to these questions were systematically investigated for all data dealing with the situation (recorded data and confrontational responses), and EUMs were labeled by conjugated action verbs. The chronological chaining of the EUMs resulted into condensed narratives for each situation, as illustrated in the following example concerning an athlete: (a) Feels disappointed by his results (feeling), (b) approaches the coach (action), (c) asks the coach if his arrows are on the right (communication), (d) understands that the coach has not seen the end (interpretation), (e) informs the coach of his score and his adjustments (communication), (f) recognizes a typical piece of coach's advice about confidence (interpretation), and (g) agrees to the proposition of the coach (communication).

The following steps consisted of examining the coherence relationships among EUMs, for each particular course of action. Two types of coherence relationship among EUMs were predetermined: (a) sequential coherence relationships, and (b) serial coherence relationships. EUMs make up a *sequence* when they follow in close succession, each one determining the following one, within the framework of an actor's specific preoccupation. In certain cases, a sequence can be discontinued, or interrupted by a EUM included in another sequence. The sequences are identified by unconjugated action verbs according to two categories: executory sequences during which the first goal of the actor is to produce changes in the

situation (e.g., advise an athlete), and exploratory sequences during which either the individual is engaged in an activity of information-seeking (e.g., observing an athlete's performance) or interpretation (e.g., proposing several hypotheses). For instance, an athlete's sequence labeled "to inform the coach about the way he performed in the last ends" would be composed of three successive EUMs such as: (a) informs the coach of his scores and his adjustments, (b) informs the coach of his difficulties in achieving a good performance, and (c) informs the coach of his lack of concentration on his routine. Several sequences can be linked in a wider sequential coherence relationship, making up *macrosequences*. Nouns are used to refer to macrosequences, which correspond to a wide preoccupation of the actor. For example, an athlete's macrosequence labeled "Analysis of decrease in performance with the coach" would be composed of sequences such as: (a) To seek to engage in communication with coach, (b) to inform the coach about the way he performed in the last ends, (c) to orient the discussion with the coach on stability, and (d) to recognize a typical piece of coach's advice.

Furthermore, EUMs are in a serial coherence relationships when they refer to preoccupations of the actor which occur repeatedly throughout a situation, but do not form part of a sequential coherence relation. In this case, EUMs make up a *series*, which is identified by an unconjugated action verb. For example, an athlete's series labeled "to recuperate between two events," could include the following non-successive EUMs: (a) isolates himself in the training room, (b) listens to the music on his walkman, and (c) reads a magazine. Series refer to more general preoccupations than sequences or macrosequences, therefore, a series could also be made up of sequences or macrosequences.

Finally, *archetypal structures* (regularities) at the global level of the courses of action were identified. Thus, sequences, macrosequences, and series of the particular courses of action were systematically compared and contrasted. In this way the similarities and differences in their composition could be detected. This step could be compared to the procedure used in traditional qualitative research, which consists of identifying the common features among categories, in order to regroup them into larger or more encompassing categories (Strauss & Corbin, 1990; Tesch, 1990).

*Analysis of the collective courses of action.* Data analysis concerning the collective courses of action consisted of: (a) connecting condensed narratives of the coach and athlete related to a particular interactive situation, and (b) examining the coordination of the two courses of action. In order to connect condensed narratives of the coach and athlete, the chain of EUMs of each course of action was written in parallel and organized chronologically. Then, comparison of the points of view of the actors, and identification of significant changes in the course of action of each protagonist, helped identify modifications in the collective activity, and characterize the coordination of the courses of action of the coach and athlete. Figure 1 reports an example of a chain of EUMs. First, differences in causal attributions of the athlete's poor performance can be identified (opposition of points of view). Second, a consensus about the more appropriate solution given the time pressure can be identified (partial agreement).

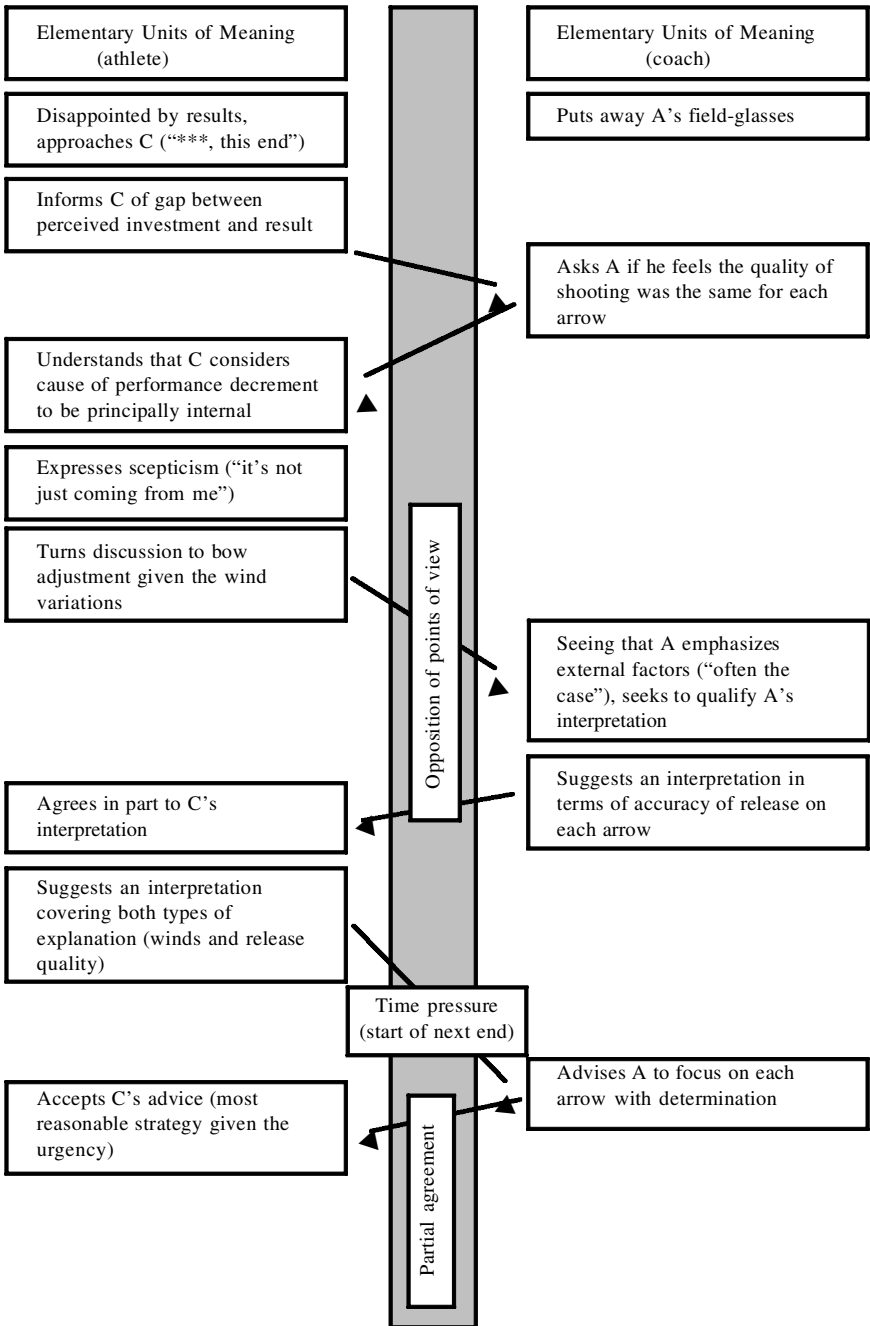


Figure 1. Example of a chain of EUMs with opposition of points of view and partial agreement.

### *Assuring Credibility*

Several measures were taken to enhance the credibility of the data (Lincoln & Guba, 1985). First, transcripts were returned to the participants to ensure the authenticity of their commentary, and to allow them to make any changes to the text. Minor editorial comments were made regarding confrontational responses. Secondly, data were independently coded by two investigators, who reached a consensus on the number and designation of EUMs, sequences, macrosequences, series, and archetypal structures. Two other experienced researchers, considered as «disinterested peers» (Lincoln & Guba, 1985, p. 308) verified the analysis. Finally, results were carefully read by the participants, until agreement was reached.

## RESULTS

The researchers agreed to divide the transcripts into a total of 404 EUMs. Analysis of the individual courses of action of the coach brought to light 11 sequences, three macrosequences, and four series. Analysis of the individual courses of action of the athletes resulted in 14 sequences, four macrosequences, and three series. Finally, analysis of the collective courses of action showed two types of coordination of the coach's and athletes' individual courses of action.

### *Archetypal Structures of the Coach's Courses of Action*

*Coach's archetypal sequences.* The 11 archetypal sequences of the coach's courses of action are identified in Table 1, according to the two predetermined categories: executory sequences, and exploratory sequences. For instance, the sequence, to get information on the classification of the archer compared to other competitors, was typically made up of the three following EUMs: (a) taking his binoculars, (b) looking at the classification table next to the training field, and (c) taking notes about an archer's classification compared to other competitors. Nine sequences participated in the archetypal structures of the macrosequences.

*Coach's archetypal macrosequences.* The three macrosequences that were identified from the coach's courses of action were labeled as: (a) analysis, initiated by an archer, of a decrease in performance with no preliminary observation; (b) analysis, initiated by an archer, of a decrease in performance after preliminary observation; and (c) emergency intervention by the coach for an archer in a critical situation (Figure 2).

*Analysis, initiated by an archer, of a decrease in performance with no preliminary observation.* In this first type of macrosequence, the coach had no knowledge about the events and the archer's difficulties when the archer consulted him. Thus, the first sequence, to get the archer to express his point of view, aimed to help him to represent the experience of the athlete in the particular situation. The following excerpt illustrates this preoccupation:

I knew very well that if he was coming to me with that long face, something was

**Table 1**  
**Archetypal Sequences of the Coach's Course of Action**

Executory sequences	Exploratory sequences
1. To orient the discussion with an archer on a particular point	1. To observe how an archer performs during an end
2. To suggest information or interpretations to an archer about how he performed in an end or an event	2. To observe an archer's scores during an end
3. To contrast or confirm his own interpretations with those of an archer	3. To notice wind variations
4. To advise an archer	4. To observe an archer's emotional reaction following disappointing results
	5. To get an archer to express his point of view
	6. To develop one or several hypotheses to explain an archer's decrease in performance
	7. To get information on the classification of the archer compared to other competitors

wrong. So, since I hadn't been watching him, I started by asking him to tell me his scores, and how he dealt with his aim to know what he had been doing. (C's self-confrontation verbalizations)

In the second sequence, in order to develop one or several hypotheses to explain the archer's decrease in performance, the coach used information from the preceding sequence and from his intimate experience with the archer, as expressed in the following quotation:

Based on what he had been telling me regarding his commitment, and knowing he was not . . . , well, he was a bit fuzzy these days, I was thinking that he wasn't clear-minded in his motivation. (C's self-confrontation verbalizations)

The sequence which followed aimed to propose an interpretation to the archer about how he performed during the end or the event. For instance, the following excerpt illustrates an interpretation in terms of lack of confidence because of previous poor shots.

There I was thinking that he was stuck on that bad feeling from the previous end. And little by little, he was totally losing confidence and what he is capable of. Yes, that's what I was thinking, so I told him. (C's self-confrontation verbalizations)

The fourth sequence allowed the coach to confirm or contrast his own interpretations with those of the archer, according to his reactions. The following quotation illustrates an agreement between the coach and the athlete:

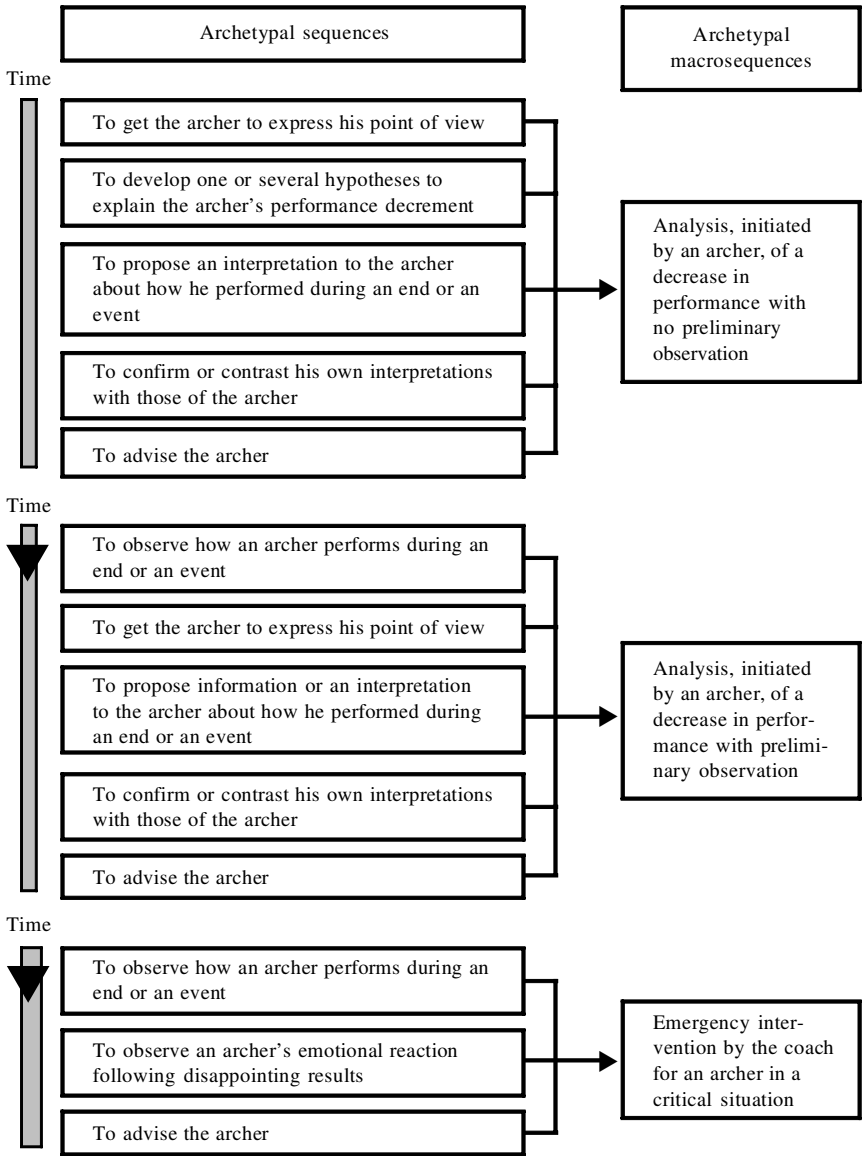


Figure 2. Composition of the archetypal macrosequences of the coach's courses of action.

See, he acknowledged right after that the bad arrows from the first end made him doubt. We agreed on that, totally. (C's self-confrontation verbalizations)

The last sequence typically aimed to advise the archer. The coach's main advice consisted of focusing the archer on a positive shooting process in terms of regularity, mental engagement, stability and precision. This advice also included avoiding concentrating on external factors such as wind, scores, or other competitors.

*Analysis, initiated by an archer, of a decrease in performance with preliminary observation.* This second macrosequence was initiated by the sequence, observe how an archer performs during an end or an event. This observation and the intimate knowledge that the coach had about the archer, allowed him to construct a hypothesis explaining the performance (e.g., the wind coming from the right) before engaging in communication with the archer. In the second sequence, when there was no time pressure, the coach's conceptions led him to get the archer to express his point of view. The coach considered that this sequence should help the archer to better understand his propositions, and to better accept his advice. The three following sequences, propose information or an interpretation to the archer about how he performed during an end or an event, confirm or contrast his own interpretations with those of the archer, and advise the archer, were consistent with those aforementioned in the description of the first macrosequence.

*Emergency intervention by the coach for an archer in a critical situation.* While the two previous macrosequences were initiated by the archer, the third macrosequence was based on the coach's initiative. The first sequence, to observe how an archer performs during an end or an event, was consistent with what was already outlined in the second macrosequence. The second sequence, to observe an archer's emotional reactions following disappointing results, associated with the intimate connection the coach had experienced with the athlete, typically led him to believe that the archer could not cope with the situation alone, and needed help.

### *Coach's Archetypal Series*

Four series, referring to wide preoccupations of the coach during the two competitions, were identified: (a) keep track of the evolution of an archer's score, (b) respect a successful archer's approach, (c) respect an archer in a solution-seeking process, and (d) discuss a performance with an archer.

*Keep track of the evolution of an archer's score.* This first series included two non-chronological sequences: (a) observe an archer's scores during an end, and (b) get information on the classification of the athlete compared to other competitors. Both of these sequences revealed a wide preoccupation of the coach which consisted of keeping track of the evolution of an archer's score.

*Respect a successful archer's approach.* This second series included two archetypal sequences (observe how an archer performs during an end or an event, and

observe an archer's scores during an end), and five archetypal EUMs: (a) notes good arrows, (b) thinks the archer does not need to be distracted from his shooting process, (c) encourages an archer, (d) congratulates an archer, and (e) smiles at an archer.

*Respect an archer in a solution-seeking process.* This series was made up of two archetypal sequences (observe how an archer performs during an end or an event, and observe an archer's scores during an end), and three archetypal EUMs: (a) notes bad arrows, (b) thinks that the archer is disrupted during his effective shooting process, and (c) thinks that the archer can cope with the situation.

*Discuss a performance with an archer.* The two non-chronological macrosequences, (a) analysis, initiated by the archer, of a decrease in performance with no preliminary observation; and (b) analysis, initiated by the archer, of a decrease in performance with preliminary observation, as described in the previous section, both participated in the broad preoccupation of the coach which consisted of discussing a performance with an archer.

#### *Archetypal Structures of Athletes Courses of Action*

*Athletes' archetypal sequences.* The 14 archetypal sequences of the athletes' courses of action are identified in Table 2. For instance, the sequence to keep track of the competitor's score during an end, typically consisted of: (a) looking at the location of the arrows on the competitor's target, and (b) comparing the competitor's scores with his own scores. Ten sequences made up the athletes' archetypal macrosequences, and are illustrated in the next paragraphs.

*Athletes' archetypal macrosequences.* The four macrosequences that were identified from the athletes' courses of action were labeled as: (a) maintenance of a successful shooting state after favorable results, (b) individual seeking solutions after disappointing results, (c) seeking help from the coach after a decrease in performance observed by the coach, and (d) seeking help from the coach after a decrease in performance not observed by the coach. Figure 3 reports the organization of the four macrosequences.

*Maintenance of a successful shooting state after favorable results.* This macrosequence was characterized by successful performances, and was composed of two sequences. During the first sequence, to retrieve arrows after an end or event, the archer walked towards the target, removed his arrows, and came back to the firing line, with a feeling of satisfaction. In the second sequence, he endeavored to stay concentrated on the shooting strategy, however good was the score.

*Individual seeking solutions after disappointing results.* Contrary to the previous macrosequence, the second macrosequence was characterized by unsuccessful performances. During the first sequence, to retrieve arrows after an end or event, the archer (a) walked towards the target, (b) removed his arrows, and (c) came back to the firing line, with a feeling of disappointment. During the next sequence, to try to recover his shooting state, the archer typically: (a) tried to

**Table 2**  
**Archetypal Sequences of Athletes' Courses of Action**

Executory sequences	Exploratory sequences
1. To seek to engage in communication with the coach	1. To keep track of the competitor's score during an end
2. To orient the discussion with the coach on a particular point	2. To try to recover his shooting process
3. To inform the coach about the way he performed in an end or an event	3. To ask the coach what's wrong
4. To contrast or confirm his own interpretations with those of the coach	4. To recognize typical piece of coach's advice
5. To stand aside from the group of archers	5. To reformulate tacitly the advice of the coach
6. To approach the coach	
7. To approach the group of archers	
8. To retrieve arrows after an end or event	
9. To stay concentrated on the shooting strategy however good was the score	

relax, (b) imagined the whole shooting process (or part of it), and (c) talked to himself.

*Seeking help from the coach after a decrease in performance observed by the coach.* This third macrosequence was initiated by a sequence labeled to seek to engage in communication with the coach. In this sequence, the archer typically approached the coach and informed him about his scores or his emotions. The next sequence was made up with EUMs which aimed to inform the coach about the way he performed in an end or event, as illustrated in the following quotation:

I shot those arrows without concentration, being too sure of what the arrow was going to do and not what I had to do. You know, I didn't maintain accuracy all the way to the end, and pow! . . . (A2-C communication)

In the third sequence, the archer's knowledge (or his perception) that the coach had observed him, typically led him to ask the coach directly what was wrong. Then, the fourth sequence enabled the archer to confirm or contrast his own interpretation with that of the coach. The following quotation illustrates agreement between the coach and one of the athletes: «Well, that's one thing we sure agreed on, I think. But basically, when he observes me well, that's often the case» (A2's self-confrontation verbalizations). Finally, the last sequence, to tacitly reformulate the coach's advice, consisted for the archer of adapting the advice of the coach by selecting the most significant instructions, or rendering them more operational, as expressed by this athlete:

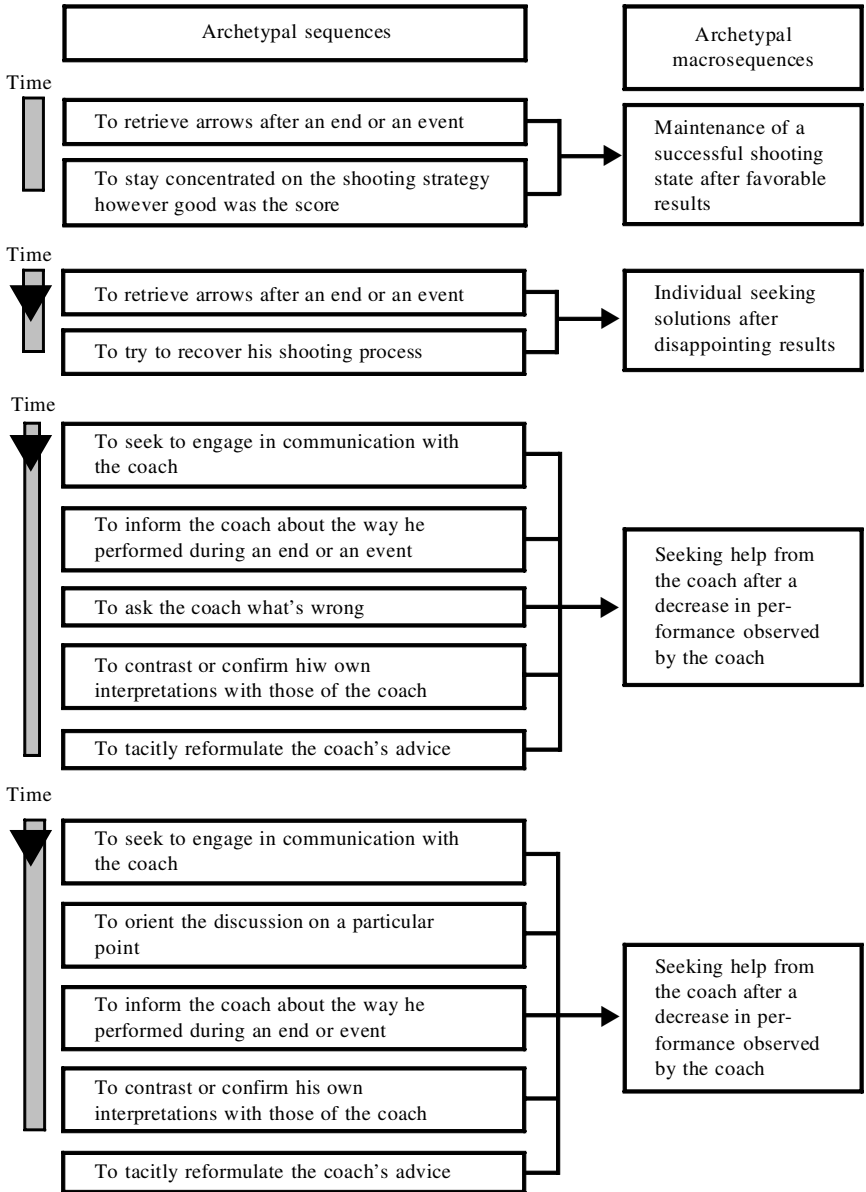


Figure 3. Composition of the archetypal macrosequences of the athletes' courses of action.

When he told me to raise the demand-level and to have the energy necessary for shooting within the routine, concretely, when I got to the first arrow, I said to myself: 'Go on, stick it in!' (A4's self-confrontation verbalizations)

*Seeking help from the coach after a decrease in performance not observed by the coach.* Consistent with the third macrosequence, this last macrosequence was initiated by the sequence, to seek to engage in communication with the coach. Then, the archer typically aimed to orient the discussion on a particular point, because he knew (or rapidly perceived) that the coach had not observed him. The next sequences, to inform the coach about the way he performed in an end or an event, to confirm or contrast his own interpretation with that of the coach, and to tacitly reformulate the advice of the coach were consistent with the description of the previous macrosequence.

### *Athletes' Archetypal Series*

Four series, referring to the broad preoccupations of the athletes during the two competitions, were identified: (a) situate oneself in relation to the general classification, (b) recuperate between two events, (c) work alone, and (d) use the coach as an information resource in the case of persistent performance decrements.

*Situate oneself in relation to the general classification.* This series was made up of the archetypal sequence, keep track of the competitor's score, and by the three following archetypal EUMs: (a) looks at the classification table, (b) listens carefully to the scores and the classification announced through the microphone, (c) asks the coach (or a peer) about the scores and the classification.

*Recuperate between two events.* This second series included five archetypal archetypal EUMs: (a) isolates himself in the training room, (b) listens to the music on his walkman, (c) plays with a 'Rubik's cube,' (d) reads a magazine, and (e) eats sweets.

*Work alone.* The two archetypal macrosequences, maintenance of a successful shooting state after favorable results, and individual seeking solutions after disappointing results, described in the previous paragraphs, both participated in a broad preoccupation of the archers labeled "work alone."

*Use the coach as an information resource in the case of persistent performance decrements.* The two archetypal macrosequences, seeking help from the coach after a decrease in performance observed by the coach, and seeking help from the coach after a decrease in performance not observed by the coach, both contributed to another broad preoccupation of the archers. This consisted of using the coach as a resource for information in the case of persistent performance decrements.

### *Coach's and Athletes' Collective Courses of Action*

The coach's and athletes' collective courses of action, which occurred in interactive situations with communication, were analyzed. This analysis resulted in

two types of coordination of the coach's and athletes' courses of action: (a) immediate convergence of coach's and athlete's courses of action, and (b) convergence of coach's and athlete's courses of action constructed through negotiation.

*Immediate convergence of the coach's and athletes' courses of action.* An immediate convergence between the coach's course of action and the athletes' course of action was identified in sequences in which the actors were preoccupied from the start by the same element of the situation. This form of convergence was observed in situations bringing together the sequences making up the archetypal macrosequences: analysis, initiated by an archer, of a decrease in performance after preliminary observation (coach) and seeking help from the coach after a decrease in performance observed by the coach (athlete). The typical chaining of the sequences of the coach and the athlete in such situations consisted of (a) seeking to engage in communication with the coach, (b) getting the archer to express his point of view, (c) informing the coach about the performance during an end or an event, (d) proposing an interpretation to the archer about the way he performed, (e) confirming his own interpretation with that of the coach, (f) advising the archer, and (g) tacitly reformulating the coach's advice.

Comparison of the points of view of the actors and identification of significant changes in the courses of action, brought to light two conditions for the immediate convergence of ideas. First, the coach's observation of the archer during an end or an event, along with his intimate knowledge of the athlete's behavior and attitudes during training or in previous competitions, produced the same perceptions of the situation on the part of the coach and the archer. The following quotation illustrates such an immediate meeting of minds:

You see, there, that was perfect. We got right away on the same wave-length. And it's almost always the case when I stand behind them and observe them. We spend so much time together that we know one another almost by heart! (C's self-confrontation verbalizations)

Secondly, the archer's description of his experience (regarding his shooting process, scores, feelings, or thoughts during the event) typically allowed the coach to elaborate upon his previous interpretations or his solutions. This verbalization process also enabled the archer to be aware of his difficulties, and to better understand and accept the coach's advice, as expressed by this athlete:

There, you see, first he is asking me what I think about it. You go to him get an answer and first he makes you talk. He's funny that way . . . when he knows all along what's wrong. He was right behind me! But it forces me to analyze better what I do, that's for sure, and to become more aware of all this. There, you know, I am explaining the score business, and already while I'm saying this I begin to understand how I shot and what I have yet to set up. (A3's self-confrontation verbalizations)

*Convergence of the coach's and athletes' courses of action constructed through negotiation.* In other situations, convergence between courses of action did not

occur immediately, but was the result of a collaborative construction. This took the form of a joint search for interpretations or solutions, with or without demonstrating disagreement. Such a negotiation was identified in the following sequences making up the archetypal macrosequences: analysis, initiated by the archer, of a decrease in performance with no preliminary observation (coach) and seeking help from the coach after a decrease in performance not observed by the coach (athlete).

Comparison of the points of view of the actors and identification of significant changes in their courses of action brought to light two types of negotiation depending on the temporal characteristics of the situations. When time constraints allowed the coach and the athlete to continue the exchange long enough, negotiations consisted of (a) opposing points of view, (b) a joint seeking of interpretations, and (c) a consensus about the most appropriate solution, as characterized by this quotation:

At first we didn't see things from the same standpoint, you know. He thought he had a problem focusing during the aiming phase, and I was thinking that there was a problem with the stabiliser, which was poorly adjusted, and a lack of experience with these new arrows. Finally he acknowledged that he was uncomfortable with this, and that it was a hell of a mistake to have changed equipment the day before a tournament, a stupid novice mistake! So then, we agreed that it was worth trying changing the bow settings, even if this is something I really hate to do in general. (Coach's self-confrontation interview)

In contrast, in situations in which there was time pressure, negotiation was also initiated by an opposition of points of view and a joint search for interpretations, but resulted in generic suggestions from the coach, such as reminding the athlete of his specific competition strategy.

## DISCUSSION

The purpose of the present study was to analyze the temporal and contextual organization of coach-athlete interactions in elite male archery competitions. Based on an innovative methodology inspired from ergonomics research, the results outlined in this paper contribute to our understanding of the analysis of coaching excellence in real settings, and provide tools to better comprehend coaches' and athletes' individual and collective work.

The main archetypal structures of the coach's courses of action (e.g., respect of a successful archer's approach, respect an archer in a solution seeking process, analysis with the archer of decreases in performance) reflect, on the part of the coach, a certain conception of the means of helping an athlete's performance during competitions. In this conception, respect for the athlete's autonomy and development of the athlete's responsibilities appear as central, consistent with the d'Arripe-Longueville and Fournier (1998) research. These findings also parallel earlier studies in the coaching literature regarding expert gymnastic coaches (Côté

& Salmela, 1996; Côté, Salmela, & Russell, 1995), rowing coaches (Côté & Dowd, 1996), sailing coaches (Saury et al., 1997), and general coaching behaviors (Salmela, 1996). However, the results of the present study differ from sport contexts with political and financial stakes such as professional ice hockey (Salmela, 1996), or culturally based authoritative leadership styles observed in French judo (d'Arripe-Longueville et al., 1998).

Analysis of the courses of action of the expert archery coach also specifies that the conditions for the respect of the athlete's autonomy in competitive settings depend on the perceived characteristics of the situations on the part of the coach. In situations that were deemed favorable by the coach for the archer's performance (i.e., when good arrows were noticed, or when the archer engaged alone in a solution-seeking process), the coach respected the athlete's approach and avoided intervening and discussing his shooting process. In contrast, in situations perceived as unfavorable for the archer's performance (i.e., when bad shots accumulated and the archer was assumed to need help), the coach placed greater importance on being at the archer's disposal and encouraged him to initiate the interaction and to interpret his own results. This attitude was particularly manifest in the recurring sequence, get the archer to express his point of view, even when there was preliminary observation on the part of the coach. That does not mean that the coach never took the initiative in the interaction and never spontaneously offered help. In fact, one of the coach's archetypal macrosequence was characterized by emergency interventions which mainly occurred when the athletes were in critical situations, or when time was short.

More generally, the coach's activity in competition situations was mainly characterized by exploratory sequences. Seven archetypal macrosequences out of 11 were exploratory, while only four macrosequences were executory. The exploratory sequences consisted of (a) observing the athletes (e.g., to observe how an archer performs during an end), (b) collecting information about the competition context (e.g., to notice wind variations), (c) listening to the athletes (e.g., to get an archer to express his point of view), and (d) interpreting events (e.g., to develop one or several hypotheses to explain an archer's decrease in performance). The executory sequences were characterized by interventions aimed at helping the athletes (e.g., to orient the discussion with an archer on a particular point). These findings are consistent with the Côté et al. (1995) model of coaching excellence. In fact, the coaching situations are described as ill-defined problems that arise in singular and uncertain contexts, and require from the coach an important activity of identification and interpretation. Côté et al. also hypothesized that the coaches' activities were determined by their mental model of the athletes' potential, which could be adjusted during particular events. The exploratory sequences which emerged in the present study show that the activity of this expert coach mainly consisted of adapting to the contextual constraints. These results usefully complement previous research on expert coaching that have described coaches' activities as routines or intervention strategies (e.g., d'Arripe-Longueville et al., 1998; Bloom, Durand-Bush, & Salmela, 1997; Sedgwick, Côté, & Dowd, 1997).

The archetypal structures of the athletes' courses of action provide additional

support to the coach's educational approach. These archetypal structures were characterized by autonomous functioning (e.g., maintenance of a successful shooting state after favorable results, individual seeking solutions after disappointing results), and by use of the coach as an information resource in the case of persistent performance decrements. In such disrupted situations, the athletes generally initiated the interaction with the coach to explain their poor performance (e.g., lack of mental readiness), and to rapidly find solutions for the next event (e.g., adjust the peep sight and be concentrated on each arrow). The characteristics of the individual coach's and athletes' courses of action reflect an approach which is consistent with certain ideas developed in the field of the ergonomic analysis of work situations, contrasting notions of tool and "cognitive prosthesis" (e.g., Reason, 1987). Help is seen as instrumental (tool) when it allows individuals to figure out solutions for themselves as opposed to help that directly supplies a ready-made solution (prosthesis). In the present study, the athlete's environment (which includes the coach) can be an aid in overcoming difficulties, but does not preclude the athlete's own analysis and interpretations. This conception leads us to consider the athlete as the fundamental element behind the intelligence and adaptability of the performance-production system.

Furthermore, analysis of the coach's and athletes' collective courses of action showed that the convergence within the dyad was variable, almost depending on the type of observation on the part of the coach. In situations with preliminary observations, the convergence was generally immediate, because the coach and the athlete had similar perceptions of the situation. In this case, the coach proposed a solution which most often corresponded to the needs of the athlete, and which was directly accepted. Here, the convergence seemed to be linked to the capacities of the coach and the athlete to take immediate advantage of a shared history which favored the meeting of minds (Theureau & Filippi, 1994, in press). In other situations, particularly when the coach could not observe the athlete during an end, interpretations and solutions were negotiated within the dyad. When there were no time pressures, the convergence of courses of action seemed to be the result of the construction of a collective history, corresponding to an adjustment of incomplete or different perspectives (Saury, 1998; Theureau & Filippi, 1994, in press). The actors could create links with past experiences in the manner of typical events (Rosch, 1978; Saury et al., 1997), or create new knowledge adapted to the particular characteristics of the situation (Hutchins, 1995).

In addition, the athletes generally tacitly redefined the coach's instructions, in order to adapt them to their own functioning. This coach-athlete coordination shows that cooperation is not an a priori given and that actors do not trust blindly. Consistent with ergonomics research (e.g., Leplat, 1991, 1994), the notion of a mutual referent appears to be a prerequisite for the coach-athlete collective activity. Although the identification of a common objective between the coach and the athlete is always possible at a general level (e.g., achieving the goal set for the competition), the actors often become involved in different ways in the same situation. The idea that the mutual referent is constructed when carrying out a particular task developed in conversational analysis (Sacks, Schegloff, & Jefferson, 1974;

Goodwin, 1981), and in ergonomics research (de Terssac & Chabaud, 1990; Theureau & Filippi, 1994, in press) seems, therefore, particularly pertinent in such sports settings. In the coaching domain, this idea has been developed by Saury and Durand (1998) who found that the involvement of the coaches in the training situations was based on past experiences with the athletes, and was characterized by negotiation of training task constraints with the athletes and shared responsibilities. The present study on elite archers would, therefore, confirm that coaching is the consequence of a collective construction on the part of the coach and the athlete, and is not only under the coach's control.

Finally, the results provided in this study indicate that the coordination of individual coach's and athletes' activities was a function of the time factor. Interaction between the actors often appeared to be under the control of temporal constraints inherent in competitive situations (e.g., the time remaining before the next end or the next event). Thus, when there were time pressures, a total agreement within the dyad was not generally reached. In such a case, the coach preferred to give the archer generic advice rather than to take risks of giving him irrelevant instruction, or leaving him in doubt by not saying anything. The temporal aspects of coach-athlete activity also have to be taken into account to understand the characteristics of the macrosequence, emergency interventions by the coach for an archer in a critical situation. Such interventions aimed at providing help within temporal constraints are consistent with previous findings reported in work situations where there was an element of emergency and a need for fast and efficient decisions (e.g., Rogalski, 1991).

In conclusion, the present research demonstrated a high level of interdependence between athlete autonomy and coach-athlete cooperation during elite male archery competitions. This is similar to certain models of cooperative systems in organizational psychology and ergonomics. The results outlined in this paper also demonstrated the constructed and situated nature of coach-athlete cooperation, which emerged from the interaction between the actors in an unplanned way. Such findings suggest that coach-athlete interaction must incorporate both a sensitivity to local circumstances and resources for the remedy of problems in understanding that inevitably arise. More generally, this study shows the interest of theoretical and methodological frameworks used in ergonomics research, for the analysis of coaching expertise. The course of action methodology which includes observed and recorded data and self-confrontation interviews appears as an interesting compromise between systematic observation tools such as the Coaching Behavior Assessment System (CBAS; Smith, Smoll, & Hunt, 1977), and in-depth interviews used in more recent studies dealing with coaching excellence (e.g., Côté et al., 1995). This innovative approach which enables the activities and the thinking processes of coaches and athletes in particular situations to be analyzed in depth, has been used in the training program of the French national team in preparation for the 1999 archery World championships and the Sydney Olympic Games. Such frameworks could help other practitioners be more aware of their actions, communication and preoccupations in training or competitive situations, and to improve the coordination of their respective activities.

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