

A Dynamical Systems Perspective on Goal Involvement States in Sport

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Based on the dynamical systems perspective, the present study aimed to explore how states of involvement toward mastery, performance-approach, and performance-avoidance goals (Elliot & Church, 1997) flow, are interrelated, and are activated during a practice judo combat. Using a retrospective video recall method, two male national level judo competitors expressed on a computer their moment-to-moment level of involvement toward each goal. Self-confrontation interviews also based on the video were immediately conducted. Analyses of variance revealed differences in levels of each goal between periods of the combat. Windowed cross-correlation analyses showed that the patterns of relationships between the time series of the different goals considered two-by-two included either high positive, high negative, or zero correlations, depending on the moment. Qualitative data analyses supported these findings and suggested that goal involvement states emerged and fluctuated according to the ecological constraints of the situation, such as the initial contextual conditions and the course of action.

Key Words: achievement goals, complex systems, motivation

Research on achievement goals in sport has increased our understanding of individuals' motivational processes (Duda, 2001; Roberts, 2001). This research has mainly borrowed the tenets of Nicholls' (1984, 1989) achievement goal theory. According to Nicholls (1989), goal orientations are an individual's tendency to be task- or ego-involved in specific situations, whereas being task- or ego-involved reflect different states of goal involvement. Being task-involved means seeking to master a task at hand, while an ego-involved state refers to the goal of outperforming others or avoiding unfavorable normative judgments. Goal orientations interact with context to determine states of goal involvement, which in turn contribute to influence the adoption of specific motivational patterns. Despite this proximal and crucial role of goal involvement in determining achievement behaviors, re-

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search has mainly addressed goal orientations, whereas goal involvement states per se have received little direct attention. In fact, as pointed out by Swain and Harwood (1996), these states are most often assumed to naturally ensue from goal orientations and/or be activated by a given context, but are seldom directly assessed.

Goal involvement refers to the concept of achievement, i.e., the self- or norm-referenced criteria that are used to define success and appraise one's competence in a given situation. This seemingly dichotomous perspective has led to the consideration of "two qualitatively contrasting types of achievement goal for the rational intention of demonstrating ability within achievement contexts" (Harwood & Swain, 1998, p. 357). However, according to Nicholls (1989), when an ego-involved individual cannot demonstrate superiority, he or she has no choice but to try to avoid demonstrating low ability. The goal of avoiding the demonstration of low ability is assumed to play a major role in the adoption of maladaptive motivational patterns (Nicholls, 1989). Surprisingly, the study of this third type of goal has been virtually neglected by both educational and sport psychology researchers who embraced Nicholls' tenets.

A renewed interest in the motivational functions of avoidance goals in academics (e.g., Elliot, 1999; Elliot & Church, 1997) and in sport and physical activities (Cury, Elliot, Sarrazin, Da Fonseca, & Rufo, 2002) has recently been aroused by considering three types of goals:¹ mastery goals, performance-approach goals, and performance-avoidance goals. While the first two respectively parallel Nicholls' (1989) constructs of task and ego, the latter reflects the desire to avoid failure. Consequently, we consider involvement toward a specific achievement goal as a momentary intention to cope with a particular achievement situation, underpinned by the desire to generate, enhance, or preserve a self- or norm-referenced sense of competence.

One of the debated characteristics about goal involvement is whether an individual can experience more than one state at a given moment (Harwood & Hardy, 2001; Harwood, Hardy, & Swain, 2000; Treasure et al., 2001). Treasure et al. (2001) consider that it is not possible to experience task and ego involvement simultaneously. Rather, states of involvement would fluctuate and undergo abrupt changes, thus only allowing one focus to dominate at a given time. By contrast, although Harwood and colleagues agree with the view of very transient states of involvement, they argue that task and ego involvement can be experienced either simultaneously or separately, thus suggesting their orthogonality (Harwood & Hardy, 2001; Harwood et al., 2000). To date, the answer to the question of the independence of states of goal involvement remains elusive. The present study was designed in part to address this question.

The fact that goal involvement may correspond to very transient psychological states evidences the necessity of taking into account the temporality of these states. However, on the one hand, the static nature of the data collection procedures (i.e., questionnaires are filled out only once) used in most achievement goal research impedes the understanding of the dynamics of goal involvement states. On the other hand, measuring goal involvement during performance seems very problematic. According to Harwood et al. (2000), this challenge could probably be taken up via some innovative procedures, such as video analyses, which could facilitate the recall of what was experienced during the action as it unfolded.

To date only one study, conducted by Smith and Harwood (2002), specifically addressed the question of the transiency and orthogonality of goal involve-

ment states. Using a retrospective video recall method, they carried out single-item discrete measurements of an elite tennis player's task and ego involvement, right after each point in four professional matches. Differences and shifts in levels of goal involvement states according to the within-match situations, and weak correlations found between task and ego involvement, respectively, supported the transiency and orthogonality of these two states.

Given the variable and transient nature of goal involvement, a dynamical systems perspective may be the most appropriate approach for studying this process. According to Nowak and Vallacher (1998), a dynamical system can be broadly defined as a set of interacting elements whose state undergoes changes in time. Indeed, the global behavior of such a system is not stationary over time and the state of the system can vary with more or less regularity in a foreseeable or erratic way. Because relationships between the elements of a dynamical system and its global behavior (called collective variable or order parameter) are nonlinear in nature, the states of the system display qualitatively different patterns that can succeed one another with abrupt changes.

Application of the dynamical approach to social psychology has already provided interesting findings concerning the ebb and flow of variables such as social judgment (Vallacher, Nowak, & Kaufman, 1994) and self-concept (Vallacher, Nowak, Froehlich, & Rockloff, 2002). To capture the flow of such variables, Vallacher and colleagues developed what they called the *mouse paradigm*. This paradigm enables tracking the moment-to-moment variations of the variable under study. For example, after being given a specific scenario, participants use a computer mouse to continuously express on a computer screen the level of what they feel regarding a specific item. Adapting such a procedure to the states of goal involvement would allow the ebb and flow of these states to be measured.

Besides the question of variability of goal involvement states, identifying the nature of the determinants that activate these states is an important theoretical and applied subject of research. According to Nicholls (1989), the probability of adopting a particular goal results from the interaction between dispositional and situational factors. Quantitative studies in the sport domain have provided interesting findings by identifying some social-environmental antecedents of goal involvement, such as the importance and consequences of the outcome of a competitive event and the type of goal-involving context that is conveyed by significant others (Harwood & Swain, 1998; Swain & Harwood, 1996). Linear statistical techniques, such as moderated hierarchical regression analyses that were used in these studies, are very appropriate for testing some hypothesized influences. However, these techniques are not designed to test more than two- or even three-factor interactions, and thus cannot account for the complexity of the interactions that can lead to any goal involvement. If goal involvement states are determined by interacting dispositional and situational variables, we do not know how many situational variables can be involved in such interactions, and whether nonhypothesized interactions between these situational variables could determine goal involvement.

In a dynamical system, the interactions among the elements are so complex that any causal mechanism in isolation cannot account for the resultant phenomenon (Nowak & Vallacher, 1998). Compared to usual quantitative methods, qualitative studies seem more suited to account for the richness of the possible antecedents of goal involvement states. Based on athletes' in-depth interviews, Harwood and

Swain (2001) found that goal involvement states are activated by complex interactions of cognitive-developmental and social-environmental factors, including cognitive-developmental skills and experiences, the motivational climate conveyed by significant others, the structural and social nature of games, and the match context. However, a major determinant of the behavior of a dynamical system at a given time is its own historicity (Fortes, Delignières, & Ninot, *in press*). Given that psychological states may undergo short-term variations, this property stresses the need to examine how the recent course of actions can influence the activation of particular goals. In Harwood and Swain's (2001) study, the wide scope of the athletes' life periods under study, from early to recent sport experiences, did not allow such a focus. Qualitative studies using self-confrontation interviews based on the video images of the actions should complement the quantitative analyses of the dynamics of goal involvement and enable an exploration of the complexity of the conditions of emergence of these goals according to time.

Based on the dynamical approach to social psychology (Nowak & Vallacher, 1998; Vallacher & Nowak, 1994), the purposes of the present study were: (a) to quantitatively and qualitatively explore how states of involvement toward mastery, performance-approach, and performance-avoidance goals (Elliot & Church, 1997) flow and are interrelated during a practice judo combat; and (b) to qualitatively examine the situational conditions of the emergence of these goal involvement states. Mastery, performance-approach, and performance-avoidance goals were expected to undergo abrupt variations and to display various patterns of synchronization revealing their independence. Because the qualitative investigation of the situational conditions of the emergence of goal involvement states was exploratory, no hypotheses were expressed concerning this purpose.

Method

Participants

Two male national level judo competitors, "Sam" (age 20) and "Mark" (age 22), voluntarily participated in the study. They had practiced their sport for 14 and 11 years, respectively, and both had won interregional championship titles. The president and the coach of the club where they trained in the suburbs of Paris gave their consent to the use of a training session for the study. Sam and Mark (not their real names) were selected from athletes who were attending the same training session. They were chosen because they were equivalent in weight and judo competence and thus were used to competing in close weight categories, at equivalent levels of performance in their respective championships.

Task and Apparatus

The task consisted of a practice combat of about 5 min. The athletes were instructed to be flexible and to engage in attacks freely and boldly, without refrain for fear of being counterattacked, and to accept being thrown down. These instructions were aimed at promoting a task-involving context in order to favor technique-focused work. A VHS portable video camera was used to record the whole training session, and particularly Sam and Mark's combat against each other.

Two portable P-III computers with 14.1-inch TFT screens² and a video monitor with video player incorporated were used to carry out a retrospective video

recall-based assessment of goal involvement states. The two computers were placed on two tables, 1.5 m in front of the video monitor screen, so that each participant could see both his computer and the monitor screens at a glance, when sitting in front of a computer.

An Hi8 portable video camera was used to record self-confrontation interviews, which were also based on the video images of the two participants' combat. This camera was placed on a telescopic tripod behind the participants' chairs so that the images from the monitor screen could be within view of the camera.

Goal Involvement Items

Three items corresponding to the three goals under study were selected from Elliot and Church's (1997) achievement goal questionnaire, and were adapted toward a focus on momentary states of goal involvement in sport. In Elliot and Church's original psychometric analysis of the complete questionnaire, these items displayed satisfactory loadings on their respective factors (mastery = .80, performance-approach = .82, performance-avoidance = .64). To ensure the fidelity of the items with respect to their original meanings, a back-translation method was used (Brislin, Lonner, & Thorndike, 1973). Thus the items selected from Elliot and Church's (1997) questionnaire were first translated from English to French by a bilingual researcher. This was followed by a second translation from French to English by an independent bilingual translator who then acknowledged the conformity of the last version to the original one. After adaptation into a state-like form, the mastery involvement item was "at this time, I desire to completely master my technique"; the performance-approach involvement item was "at this time, I am motivated by the thought of outperforming my partner"; and the performance-avoidance involvement item was "at this time, I just want to avoid doing poorly faced with my partner."

Procedure

The study was carried out during a judo training session by one male and one female researcher. At the beginning of the session, the coach introduced the two researchers to all the athletes as wishing to study the unfolding of a high level judo training session. He also said that the session would be video recorded and that some athletes might be asked to talk about training. The procedure then consisted of the three following phases: practice combat, goal involvement measurement, and self-confrontation interviews.

Practice Combat. After the warm-up, the coach informed all athletes that the whole session would consist of carrying out practice combats of about 5 min in the above-described conditions of flexibility and cooperation. The athletes were invited to change their partner for each new combat. Sam and Mark found themselves in a fight together early in the session. At this occasion and during their whole combat, the camera focused exclusively on them without their knowing it. Indeed, it was important that these two athletes did not feel themselves to be the focal points of the study and that they fought as spontaneously as possible. To take advantage of short-term memory, they were invited to leave the training mat right after their combat and were asked whether they would agree to lend themselves to further study about this combat. They were assured that the content of their contribution would remain confidential.

Goal Involvement Measurement. After both athletes gave their consent to participate in the study, they were taken to an adjacent room where the goal assessment apparatus had already been installed. Goal involvement states were measured using a procedure adapted from Vallacher et al.'s (1994) mouse paradigm and its recent developments (Vallacher et al., 2002). This procedure consisted of indicating, with a computer, the moment-to-moment levels of involvement toward each goal, while watching the combat on the video monitor.

The two participants carried out the assessment procedure of goal involvement states simultaneously, but were placed such that neither could see the other's responses. They each sat in front of a portable computer with a mouse positioned on the side of the computer corresponding to their dominant hand. They read a first screen of instructions explaining how to use the computer mouse to assess the moment-to-moment levels of goal involvement, and to relive the combat through the video images. Then a second screen of instructions proposed an exercise in which they had to train themselves to use the computer mouse for about 30 s. Moving the mouse entailed movements of a cursor on a 640-pixel long horizontal axis that was placed at the bottom of the computer screen.

This familiarization was followed by the goal involvement assessment procedure per se. The participants read on their computer screen the description and the item of one of the three goals under study, and were given the opportunity to ask for further explanation if needed. They then placed the cursor at a starting position that was a tick mark in the middle of the axis and executed the mouse assessment procedure, while watching the 5-min video of their combat.

The moment-to-moment levels of involvement toward a given goal were reflected by the continuously varying positions of the cursor on the horizontal axis which was bounded by the semantic anchors "not at all true" and "very true" above its left (0 pixel) and right extremities (640 pixels), respectively. The item of the goal in question and a brief explanation of its meaning were placed in the middle and at the top of the screen, respectively. While the participants were assessing their level of involvement toward a goal by moving the cursor with the computer mouse, a specific program recorded five times per second the distance (in pixels) between the position of the cursor and the left extremity of the axis, thus generating a time series of this distance for the ~5-min duration of the combat, exactly 1,493 data points. The videotape was rewound after each goal assessment to repeat the procedure until all three goals had been assessed. The three goals were successively presented in different order for the two participants.

Self-Confrontation Interviews. Right after the computerized measurement of goal involvement states, each participant was invited to stay in the room, one after the other, to take part in an individual self-confrontation interview. While one was solicited, the other was invited to wait his turn outside the room in the company of the male researcher. 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 one is confronted with his or her own activity in particular situations, as soon as possible after the event in question.

In the present study the two interviews were conducted by the female researcher, who had extensive experience in traditional qualitative research and self-confrontation interviewing techniques. During the interview each participant was asked to freely indicate, describe, and comment on any elements of his activity, including physical actions, communication, thoughts, or feelings that he consid-

ered significant (Theureau, 1992). Given the purposes of the study, probe questions were then used to gain a better understanding of and to enrich the participants' answers on the temporal and contextual organization of goal involvement. Various techniques (e.g., Seidman, 1991) were used to assure the authenticity of the participants' responses. First, the questions concerning the participants' activity 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 actions, and to avoid interpretations, generalizations, and self-analysis (von Cranach & Harré, 1982). The interviews lasted about 16 min each. They were videotaped and a full verbatim transcription was made of each interview.

Data Analyses

Quantitative Analyses. The quantitative analyses included all the data collected for the duration of the combat minus the first 5 s, during which the participants moved the cursor from its imposed initial position at the middle of the axis to seek their first meaningful starting position. Given that the computer recorded the position of the cursor on the axis at the frequency of 5 Hz, the following 1,468 data points (4 min, 53.6 s) were thus devoted to the statistical analyses.

Based on Vallacher et al.'s (1994; 2002) procedure, one-way multivariate and univariate analyses of variance with repeated measures on four periods of the combat, and follow-up Scheffé tests, were used to examine whether the levels of involvement toward each goal changed over time. Because ANOVAs with repeated measures require the same number of observations for each occasion of measurement (i.e., periods to be compared), the duration of the combat was arbitrarily divided into four equal periods of 367 data points each (1 min, 13.4 s), which consequently had no particular meaning regarding what occurred during the combat. Furthermore, effect sizes (*ES*), were calculated to assess the meaningfulness of the observed differences between the periods. The calculation of *ES* frees itself from the operationalization of the variables under study by translating any observed difference in standard deviation units. As advocated for repeated-measures designs (Long & van Stavel, 1995), standard deviations for the compared periods were pooled in the present study. An *ES* was considered small when lower than .41, moderate between .41 and .70, and large above .70 (Cohen, 1988).

We conducted windowed cross-correlation (e.g., Boker, Xu, Rotondo, & King, 2002) analyses to look for potential variations in the relationships between the different states of goal involvement. Traditionally, cross-correlation is merely the Pearson product-moment correlation between two time series that can be considered with different lags between them. Even though that was not necessary for the present study, this technique allows a possible time delay in the association of the series to be detected. Using traditional cross-correlation analyses assumes that this association is stationary over time. When this assumption of stationarity cannot be warranted, even more when variations in the relationships are hypothesized (i.e., the strength and/or the sign of the correlation are suspected to change over time) as in the present study, the technique must be refined by means of windowed cross-correlation.

The windowed cross-correlation technique provides a moving estimation of the association between two time series. According to Boker et al. (2002), this technique consists in selecting a vector of sequential occasions of measurement, a

window, from each of two time series X and Y such that both vectors contain the same number of occasions of measurement. The Pearson product-moment coefficient of correlation r is then calculated between the selected vectors respectively starting at the observations x_1 and y_1 , then for the vectors starting at the observations x_2 and y_2 , and so forth until the window has covered the whole series. The successive coefficients of correlation thus obtained can then be plotted to reveal the evolution over time of the degree of relationship between the phenomena under study. For the present study, the width of the window was set at 201 out of the total of 1,468 data points. This was to ensure a sufficient number of observations for statistically powerful correlation analyses and allow a maximum of steps forward for the window from the beginning to the end of the time series. This analysis was performed for the three possible combinations of the recorded series taken two-by-two, that is, mastery and performance-approach, mastery and performance-avoidance, performance-approach and performance-avoidance.

Qualitative Analyses. Qualitative data analyses were based on processing used in recent studies which borrowed a situated-action approach to examine expertise in sports (d'Arripe-Longueville, Saury, Fournier, & Durand, 2001; Hauw, Berthelot, & Durand, 2003; Sève, Saury, Ria, & Durand, 2003). One key idea of the situated-action approach (Suchman, 1987; Theureau, 1992) is that situation and activity cannot be considered separately: The situation both shapes the activity and is shaped by the activity at the same time. This approach allows for describing and finely analyzing a person's activity in accordance with its temporal dynamics, and grasping the meaning each actor gives to his or her own activity.

In the situated-action approach, data are generally analyzed according to three steps (Sève et al., 2003; Theureau, 1992). First, the participant's actions during the situation are described and self-confrontation data are transcribed verbatim. Second, elementary units of meaning (EUMs) are identified. An EUM is the smallest unit of action that is meaningful to the actor in the continuous flow of his or her activity (Theureau, 1992). According to this approach, a meaningful action is any physical action, communicative exchange, interpretation, or feeling that can be shown, told, and commented upon by the participant. Third, meaningful structures in the course of action are identified by grouping the EUMs into categories pertaining to the same theme, with or without sequential coherence.

In the present study, transcription of athletes' actions and self-confrontation data were chronologically organized in tables including: (a) time per second, (b) the participants' actions during the combat, (c) Sam's verbalizations during the self-confrontation interview, and (d) Mark's verbalizations during the self-confrontation interview. Two experienced researchers were involved in the data analysis process. Specifically, each researcher individually viewed and reviewed the tapes of the combat, checked the temporal indices of each sequence, and read the transcripts several times. The EUMs were then individually identified and classified according to three main steps. First, raw data pertaining to goal involvement were identified in relation to Elliot and Church's (1997) terminology: mastery, performance-approach, and performance-avoidance goals. Second, consistent with the purposes of the study, data related to the flow of goal involvement, the relationships between goal involvement states, and the situational conditions of emergence of these states were identified as specific EUMs. Third, these EUMs were grouped into categories corresponding to higher order themes, which in turn were

grouped into broader categories called dimensions. Summary labels were determined for each grouping level.

We took several precautions to enhance the reliability of the collection and analysis of the qualitative data. First, two expert researchers in sport psychology examined the interview transcripts to detect any questions that could have been overly general or that could have influenced the participants' comments. This verification led to the deleting of two unreliable EUMs. Second, the researchers coded the data independently and then compared and discussed the codes until they reached consensus on the labels. One of the two expert researchers in sport psychology who had a good knowledge of achievement goal theories acknowledged the relevance of the categorization in relation to Elliot and Church's (1997) conceptual framework.

Results

Consistent with the purposes of the study, the results are presented as follows: (a) preliminary analyses, (b) quantitative analyses of goal variations, (c) quantitative analyses of relationships between goals, (d) qualitative examination of goals flow, (e) qualitative examination of relationships between goals, and (f) qualitative examination of situational conditions of goal involvement.

Preliminary Analyses

The time series of the scores of goal involvement states were plotted for each participant (see Figure 1). Observation of the graphs revealed that the patterns of the different goals often looked similar over time. This was more apparent regarding all three goals for Sam, and mastery and performance-approach involvement for Mark, although Mark's performance-avoidance pattern was generally low. Correlation analyses were conducted for the entire time series of goal involvement to ascertain these global observations. For Sam, the apparent similarity of goal patterns was supported by high positive correlations between mastery and performance-approach, $r(1467) = .70, p < .001$, and between performance-approach and performance-avoidance, $r(1467) = .71, p < .001$, and by a moderate positive correlation between mastery and performance-avoidance, $r(1467) = .38, p < .001$. For Mark, as it looked on the graphs, a significant but moderate positive correlation was found between mastery and performance-approach, $r(1467) = .30, p < .001$. Very low, $r(1467) = -.10, p < .001$, or nonsignificant ($p > .05$) correlations were found between Mark's performance-approach and performance-avoidance goals and between Mark's mastery and performance-avoidance goals, respectively.

Graphs also revealed that the scores of goal involvement underwent frequent variations for both participants. Sam's score variations appeared to be most often followed by relatively stable periods, whereas Mark's scores displayed more abrupt changes from peaks to hollows in a seemingly chaotic fashion. To ascertain these observations, analyses of variance comparing scores of goal involvement between different periods of the combat are presented in the next section.

The values of the coefficient r resulting from the windowed cross-correlation analyses processed for each pair of goals were also plotted (see Figure 2). Consistent with the correlations observed for the whole time series, coefficient r seemed to fluctuate most often along positive values despite some occasional incursions into negative value areas for Sam; they appeared equally positive and

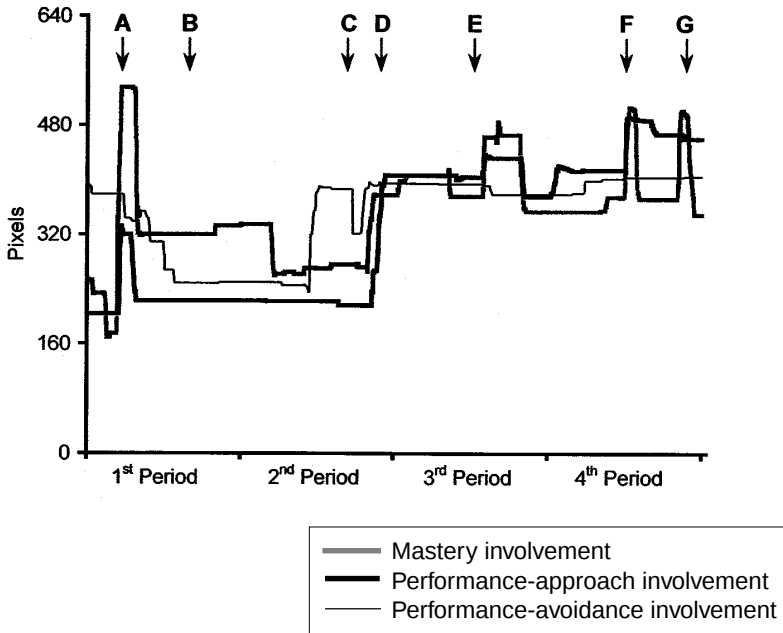
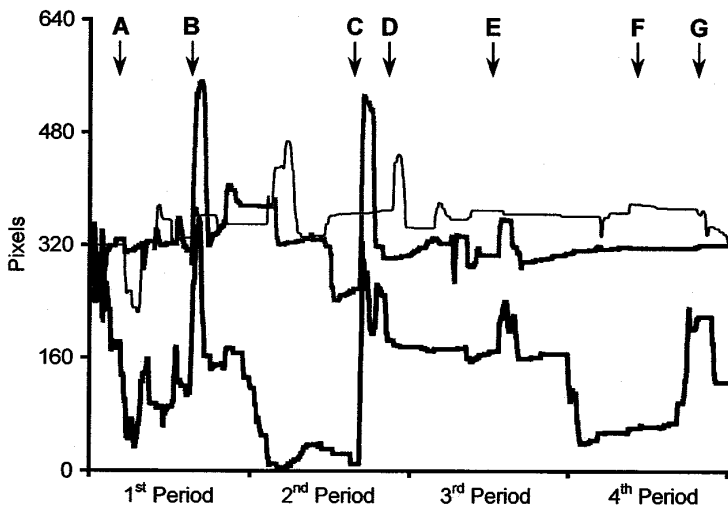
SAM**MARK**

Figure 1 — Sam's and Mark's scores of goal involvement (in pixels) according to time. Scores of goal involvement states could range from 0 pixel (no involvement) to 640 pixels (maximal involvement). Letters represent main typical events that occurred during the combat: A = Sam's successful attack; B = Sam's attack and Mark's instantaneous successful counterattack; C = Mark's successful attack; D = Sam's attack and Mark's dodge and unsuccessful counterattack; E = Mark's attack (without conviction) and Sam's instantaneous half-successful counterattack; F = Sam's attack dodged by Mark; G = Sam's half-successful attack.

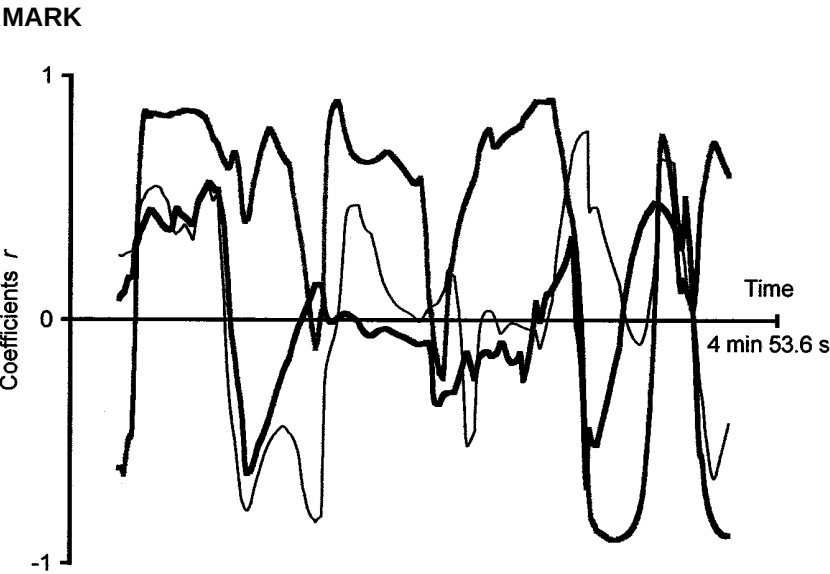
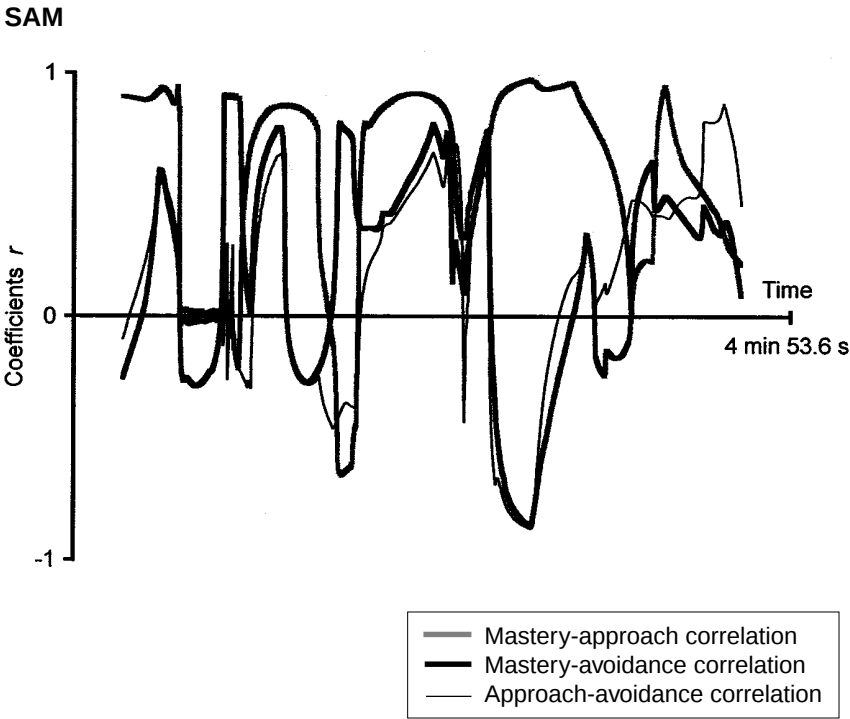


Figure 2 — Coefficient r resulting from the windowed cross-correlation analyses performed for each pair of time series of goal involvement for Sam and Mark.

Table 1 Means and Standard Deviations of Scores of Goal Involvement States (in pixels) According to the Periods ($N = 367$ data points for each)

	1st period		2nd period		3rd period		4th period	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
<u>Sam</u>								
Mastery	324.6	84.1	300.0	41.4	404.0	38.7	382.1	45.8
Performance-approach	227.6	28.8	240.1	52.8	407.6	17.7	441.8	32.3
Performance-avoidance	303.5	55.5	319.3	67.3	388.6	7.4	397.5	10.1
<u>Mark</u>								
Mastery	344.8	61.1	330.4	64.6	313.8	17.1	316.9	2.6
Performance-approach	159.6	74.4	85.9	89.4	172.9	17.3	94.7	58.1
Performance-avoidance	329.8	34.4	372.8	35.9	362.4	8.6	365.2	12.1

Note: Scores of goal involvement states could range from 0 pixel (no involvement) to 640 pixels (maximal involvement).

negative for Mark. Regardless of these general tendencies, a variety of patterns of relationships between the different goal series was observed, including positive and negative associations amid periods of independence between goals (see below). All these patterns seemed to follow one another abruptly.

Quantitative Analyses of Goal Variations

The means and standard deviations of the levels of involvement toward each goal for each of the four periods considered are listed in Table 1.

The one-way MANOVAs with the four periods as repeated measures and the three goal involvement states as multiple dependent variables yielded a significant effect of the period for Sam, Wilks' lambda = .004, $F(9, 358) = 8827.38$, $p < .001$, and for Mark, Wilks' lambda = .186, $F(9, 358) = 174.53$, $p < .001$. Follow-up ANOVAs with similar repeated measures were then conducted separately for mastery, performance-approach, and performance avoidance involvement.

Variations in Mastery Involvement. A significant effect of period was found for Sam's mastery involvement, $F(3, 1098) = 244.78$, $p < .001$. Scheffé tests indicated that his mastery involvement was higher in the third period than in the first, second, and fourth periods (all $p < .001$). Effect size analyses revealed that these first two differences were large ($ES = 1.21$ and 2.60 , respectively) and the last was moderate ($ES = .52$). Sam's mastery involvement was also higher in the fourth period than in the first and second periods (both $p < .001$), these differences being large ($ES = .85$ and 1.88 , respectively). Additionally, Sam's mastery involvement

was significantly higher in the first period than in the second one ($p < .001$), although this difference was small ($ES = .37$). A significant effect of the period was also found for Mark's mastery involvement, $F(3, 1098) = 33.06$, $p < .001$. Mark's mastery involvement was higher in the first period than in the second, third, and fourth periods (all $p < .001$). This first difference was small ($ES = .23$) and the last two were moderate ($ES = .69$ and $.65$, respectively). Mark's mastery involvement was also higher in the second period than in the third ($p < .001$) and fourth ones ($p < .01$), these difference being small ($ES = .35$ and $.30$, respectively).

All these differences observed between the periods of combat show that Sam's and Mark's mastery involvement underwent changes in the course of the combat.

Variations in Performance-Approach Involvement. A significant effect of the period was found for Sam's performance-approach involvement, $F(3, 1098) = 3459.57$, $p < .001$. Scheffé tests indicated that his performance-approach involvement was higher in the fourth period than in the first, second, and third periods (all $p < .001$). Effect size analyses revealed that all these differences were large ($ES = 7.00$, 4.61 , and 1.31 , respectively). Sam's performance-approach involvement was also higher in the third period than in the first and second periods (both $p < .001$), these differences being large ($ES = 7.52$ and 4.25 , respectively). Additionally, Sam's performance-approach involvement was significantly higher in the second period than in the first one ($p < .001$), although this difference was small ($ES = .29$). A significant effect of period was also found for Mark's performance-approach involvement, $F(3, 1098) = 204.17$, $p < .001$. His performance-approach involvement was higher in the third period than in the first ($p < .05$), second ($p < .001$), and fourth ($p < .001$) periods. This first difference was small ($ES = .25$) but the last two were large ($ES = 1.35$ and 1.82 , respectively). Mark's performance-approach involvement was also higher in the first period than in the second and fourth ones (both $p < .001$), these differences being large ($ES = .90$ and $.97$, respectively).

These differences observed between the periods of the combat show that, for both Sam and Mark, performance-approach involvement underwent variations over time.

Variations in Performance-Avoidance Involvement. A significant effect of period was found for Sam's performance-avoidance involvement, $F(3, 1098) = 331.65$, $p < .001$. Scheffé tests indicated that his performance-avoidance involvement was lower in the first period than in the second, third, and fourth periods (all $p < .001$). Effect size analyses revealed that this first difference was small ($ES = .26$) while the last two were large ($ES = 2.15$ and 2.36 , respectively). Sam's performance-avoidance involvement was also lower in the second period than in the third and fourth periods (both $p < .001$), these differences being large ($ES = 1.45$ and 1.63 , respectively). A significant effect of period was also found for Mark's performance-avoidance involvement, $F(3, 1098) = 186.10$, $p < .001$. His performance-avoidance involvement was higher in the second period than in the first ($p < .001$), third ($p < .001$), and fourth ($p < .01$) periods. This first difference was large ($ES = 1.22$) while the last two were small ($ES = .40$ and $.28$, respectively). Finally, Mark's performance-avoidance involvement was lower in the first period than in the third and fourth ones (both $p < .001$), these difference being large ($ES = 1.30$ and 1.37 , respectively).

These results show that Sam's and Mark's performance-avoidance involvement varied from one period of the combat to another.

Quantitative Analyses of Relationships Between Goals

The relationship between mastery and performance-approach involvement varied from high negative to high positive correlation, with periods of no correlation ($r \approx 0$ or $p > .05$). Coefficient r ranged from $r(200) = -.65$ to $r(200) = .97$ for Sam, and from $r(200) = -.90$, to $r(200) = .91$ for Mark (all $p < .001$). A similar range of variations with periods of no correlation was found regarding the relationship between mastery and performance-avoidance involvement, since correlations extended from $r(200) = -.86$ to $r(200) = .91$ for Sam, and from $r(200) = -.89$ to $r(200) = .56$ for Mark (all $p < .001$). Finally, the relationship between performance-approach and performance-avoidance involvement also appeared to undergo large variations, since coefficient r ranged from $r(200) = -.87$ to $r(200) = .88$ for Sam, and from $r(200) = -.83$ to $r(200) = .78$ for Mark (all $p < .001$). Phases of no significant correlation between performance-approach and performance-avoidance involvement were also found for both participants.

In sum, as suggested by the graphs (Figure 2), different patterns of relationship were found between the goal series taken two-by-two, revealing either concomitance, opposition, or independence phases for each pair of goal involvement. Subsequent qualitative data should help us understand the conditions of emergence of these patterns.

Qualitative Examination of Goals Flow

Analysis of the qualitative data led the two researchers to agree on 36 EUMs relating to how goal involvement could flow over time. Theses EUMs were indexed into three higher order themes and further abstracted into two dimensions (see Table 2). These dimensions and the higher order themes with illustrative quotations are presented below.

Dimension 1: Variations in Goal Involvement. The EUMs ($n = 28$) that were identified as pertaining to the variations in goals were divided into two higher order themes.

The first higher order theme, *Changes in the level of involvement toward a given goal* ($n = 15$), highlights how the degree of involvement toward each achievement goal under study underwent fast and large changes in the course of the combat. This can be illustrated by Sam's following statements which suggest a sudden increase in his performance-approach involvement at the beginning of the combat:

I'm seeking to begin slowly ... not to attack hard.

[5 seconds later]: Here, his position was favorable to me, ... for a hold I usually like to do. I launched into it!

These comments are consistent with the abrupt increase that appears in Sam's performance-approach graph when he was launching this specific attack (see Figure 1, Event A).

The second higher order theme, *Changes in the dominant goal focus* ($n = 13$), indicates that variations in the levels of involvement toward each goal result in numerous changes in the momentarily prevailing goal focus. The following statement exemplifies how Mark shifted from performance-approach to performance-avoidance involvement:

Table 2 Organization of Elementary Units of Meaning (EUMs) Identified From Interviews, Relative to Goal Involvement Flow, Relationships Between Goal Involvement States, and Situational Conditions of Emergence of Goal Involvement States

Dimensions	Higher order themes	Examples of UEMs
Goal Involvement Flow		
1. Variations in goal involvement (<i>n</i> = 28 EUMs)	1. Changes in the level of involvement toward a given goal (<i>n</i> = 15 EUMs) 2. Changes in the dominant goal focus (<i>n</i> = 13 EUMs)	Wanting to avoid partner's attacks, right after being thrown down. Switching from attacking intents to defending intents after marking an advantage. Repeatedly attempting to mark an advantage.
2. Stationarity of goal involvement (<i>n</i> = 8 EUMs)	1. Persistence toward the same goals (<i>n</i> = 8 EUMs)	
Relationships Between Goal Involvement States		
1. Range of patterns of relationships between goal involvement states (<i>n</i> = 22 EUMs)	1. Opposition between goal involvement states (<i>n</i> = 5 EUMs) 2. Concomitance of goal involvement states (<i>n</i> = 10 EUMs) 3. Complementarity of goal involvement states (<i>n</i> = 7 EUMs)	Wanting to attack less to avoid being counterattacked. Trying to better master a specific technical aspect while attacking more. Trying to master a specific technical aspect to prevent partner's attacks and to attack successfully.
Situational Conditions of Emergence of Goal Involvement States		
1. Initial contextual conditions (<i>n</i> = 10 EUMs)	1. Instructions from the coach (<i>n</i> = 8 EUMs) 2. Program of the training session (<i>n</i> = 2 EUMs)	Not seeking to block partner's attacks in order to respect coach's instructions of flexibility. Saving one's energy because of the numerous remaining combats to be participated in.
2. Course of action (<i>n</i> = 31 EUMs)	1. Historicity of actions (<i>n</i> = 14 EUMs) 2. Progression of the imaginary score (<i>n</i> = 4 EUMs) 3. Attack opportunities (<i>n</i> = 6 EUMs) 4. Controllability of the situation (<i>n</i> = 4 EUMs) 5. Feelings and emotions (<i>n</i> = 3 EUMs)	Wanting to attack less because of one's previous successful attack. Lowering one's intents to attack due to having marked enough points to win if the combat had been an actual competition. Taking advantage of the partner's fragile position to attempt to launch an attack. Not seeking to resist an attack which is deemed inescapable. Wanting to make the partner fall to recover one's confidence.

Here, anyway, I'm no longer strongly attacking, I'm more in a state of defense.

This comment was about a period that began when Mark attempted an attack without conviction, to which Sam counterattacked (Figure 1, Event E). Mark's graphs show that performance-approach involvement strongly decreased from that moment whereas the level of performance-avoidance involvement remained stable.³

Dimension 2: Stationarity of Goal Involvement. Some EUMs ($n = 8$) indicated periods of no change in goal involvement, leading to the possibility of a single higher order theme named *Persistence toward the same goals*. This theme shows that participants sometimes maintained the same goal involvement for a specific period. An example can be found in Sam's persistent performance-approach involvement while he was repeatedly attacking toward the end of the combat:

At that time, I really wanted to give him ..., to make him fall in order to mark a big advantage.

[25 seconds later]: Here, this is the same. He is doubling up. So, I engage. I mark an advantage.

This insistence on pursuing such a goal is supported by Sam's performance-approach graph which rose as of the first attack of the series (Figure 1, Event F) and persisted until the last one (Event G).

Qualitative Examination of Relationships Between Goals

A total of 22 EUMs addressed the relationships between different goal involvement states. These EUMs were indexed into three higher order themes and further gathered into a single dimension (see Table 2).

Dimension 1: Range of Patterns of Relationships Between Goal Involvement States. Three higher order themes appeared to organize the EUMs addressing the relationships between goals.

The first one, *Opposition between goal involvement states* ($n = 5$), shows that being highly involved toward a given goal sometimes goes with being minimally involved toward another one, as shown by Mark's comments concerning performance-avoidance and performance-approach goals:

Here I don't take too many risks ... I attack less. Now that I've done what I wanted to do, I'm going to be more careful ... to pay attention so that he doesn't make me fall too much.

Consistent with Mark's comment about the moments following his successful counterattack (Figure 1, Event B), Mark's performance-approach graph strongly decreased toward scores close to 0, whereas the performance-avoidance graph remained stable for a short time and then increased.

On the contrary, the second higher order theme, *Concomitance of goal involvement states* ($n = 10$), refers to the fact that the participants sometimes appeared to be involved toward different goals simultaneously. The example below shows Sam's high performance-avoidance/high performance-approach involvement:

Well! Here it's the second time he's given me a hiding! Right then, I have to pay more attention to this. I'll try to dominate at the guard and to attack a little more.

This state of mind for Sam after Mark's second successful attack (Figure 1, Event C) is also expressed through the concomitant increases of Sam's performance-avoidance and performance-approach graphs.

The third higher order theme relating to the relationships between goals, *Complementarity of goal involvement states* ($n = 7$), refers to the means-end relationships that can account for the observed concomitance of some goals. A good illustration of complementarity is the relationship of instrumentality which appears among mastery, performance-approach, and performance-avoidance involvement in Sam's following statement:

I'm seeking to put my right hand up to be comfortable in order to force my guard on him ... to give him less opportunity to work.

The combination of all these intentions is consistent with the persistence of the levels of Sam's three graphs, after they all rose at the same time when he launched an unsuccessful attack (Figure 1, Event D).

Qualitative Examination of Situational Conditions of Goal Involvement

A total of 41 EUMs relating to the situational conditions of emergence of goals were extracted from the transcripts. These EUMs were indexed into seven higher order themes and further abstracted into two main dimensions (see Table 2).

Dimension 1: Initial Contextual Conditions. The EUMs pertaining to the initial conditions of the context in which the task was to take place ($n = 10$) were divided up into two higher order themes.

The first higher order theme, *Instructions from the coach* ($n = 8$), emphasizes the role played by the instructions that were provided by the coach at the beginning of the training session to fight flexibly in a spirit of cooperation. These instructions seemed to have curbed the participants' desire to carry out an actual combat, and consequently their involvement toward performance-approach and performance-avoidance goals, as testified by Mark's statement:

He scored one *Yuko*,⁴ a small advantage. Anyway, I'm not struggling too much. I'm not seeking to avoid it. It's in the spirit of flexibility. I'm not struggling too much to avoid it.

This comment relating to the end of the combat is supported by the decrease in Sam's performance-approach and performance-avoidance graphs which occurred right after Mark's final series of attacks (Figure 1, Event G).

The second higher order theme of the context-specific initial conditions, *Program of the training session* ($n = 2$), reveals the importance of the coach's announcing that the whole session would be made up only of practice combats. As a result, the participants fought with the intent to save their strength for later combats. This sometimes lowered the intensity of their involvement at least toward performance-approach goals, as reflected in Mark's following report:

I put myself in the situation of still fighting for one hour.... Right then, I'm saying to myself: "Save your strength now."

This state of mind after Mark managed his second successful attack is reflected in the gradual decrease in his performance-approach graph (Figure 1, Event C).

Dimension 2: Course of Action. Five higher order themes organized the EUMs addressing the role of the course of action in the determination of the states of goal involvement ($n = 31$).

The first, *Historicity of actions* ($n = 14$), highlights how recent events that occurred in the course of action influenced the adoption of particular goals. Some examples provided above also show that undergoing one or two successful attacks from Mark aroused Sam's involvement toward mastery and performance-approach goals. On the contrary, having just carried out a successful action can then undermine performance-approach involvement and raise performance-avoidance involvement. This case is exemplified by Mark's report of his thoughts that followed his second successful attacks:

I won't attempt real attacks now, I think. I'll either do small attacks on his back or stay quiet by forcing my guard on him.

Indeed, while Mark's performance-approach graph decreased right after his second successful attack (Figure 1, Event C), his performance-avoidance graph remained stable for a while and then increased.

The second higher order theme of the course of action dimension, *Progression of the imaginary score* ($n = 4$), emphasizes that the participants counted their points as if they were in an actual competition combat. This entailed some consequences such as Mark's lowering both performance-approach and performance-avoidance goals because of his imaginary score advantage:

It's true that in my mind, when I managed to throw him down twice, because usually, in a normal combat, there would have been *Ippon*⁴ or at least two *Waza-ari*. Normally, I've won. So, next, in my mind, it is true that it's growing slack. Then, he may score one *Koka*, there would be no harm done.

This comment concerning the period that followed a small attack from Mark (Figure 1, Event E) is supported by the strong decrease in Mark's performance-approach graph and by the preservation of the already established mean level of his performance-avoidance graph at this time.

The third higher order theme, *Attack opportunities* ($n = 6$), was composed of EUMs indicating that some goals, particularly mastery and performance-approach goals, were activated by the emerging opportunities of launching a probably successful attack. The following report illustrates how Sam's perception of such an opportunity suddenly aroused his performance-approach involvement:

At this time, he launches an attack ... I block him and then, I take advantage of his action being not perfectly timed to score at least one advantage.

This report is supported by the sudden increase of Sam's performance-approach graph as Mark failed his attack (Figure 1, Event E).

The fourth higher order theme, *Controllability of the situation* ($n = 4$), indicates that the participants' intentions depended on their appraisal of whether the situation was controllable or not. For instance, when undergoing an attack from Mark, Sam lowered his performance-avoidance involvement, since he perceived himself as having few chances of dodging.

At one time, I'm unsteady. So, I feel myself starting to fall and I let myself go because, anyway, it's not sure that I could have dodged.

Sam's state of mind while falling (Figure 1, Event B) brought his performance-avoidance graph to its lowest levels of the combat.

The fifth higher order theme was labeled *Feelings and emotions* ($n = 3$). Although the purpose of the present study was not focused on affects, some EUMs addressed the presence of feelings or emotions associated with goal involvement. Sometimes goals appeared to be activated in reaction to some negative affects. Such seems to be the case for Mark while he was getting up right after having been thrown:

I'm surprised and ... I'm saying to myself: "I've got to be more careful."

This reaction that occurred a while after Mark had been thrown down early in the combat (Figure 1, Event A) corresponds to the clear-cut increase of his performance-avoidance graph. Goal involvement was sometimes associated with the intent of experiencing positive emotions such as satisfaction or feelings such as confidence. Still consider the example of Mark's reaction following his previous fall; after getting up, Mark adopted mastery and performance-approach goals to notably increase his confidence.

At this time, I'm seeking to make him react on his back. Then, when he's restabilizing himself, I'm pulling him forward ... to make him fall forward. This is to give myself confidence, following my previous fall, and well, ... also to win.

These intentions from Mark are reflected in the increases of both his mastery and performance-approach graphs while he was launching his attack (Figure 1, Event B).

Discussion

One purpose of the present study was to capture how states of mastery, performance-approach, and performance-avoidance involvement vary during a practice judo combat. Both quantitative and qualitative analyses revealed that goal involvement states were subject to fast variations that could result in frequent changes in the dominant goal focus. These findings strongly support the assumption that goal involvement can undergo abrupt changes in sport settings (Harwood & Hardy, 2001; Treasure et al., 2001). Such fluctuations in time are typical of the dynamical functioning that results from the interactions between the multiple elements of a complex system.

The second purpose of the study was to quantitatively and qualitatively capture how states of mastery, performance-approach, and performance-avoidance involvement can be interrelated. The windowed cross-correlation analyses revealed that all kinds of patterns of correlations between the different goals, considered two-by-two, occurred in the course of the combat. These patterns ranged from the highest negative to the highest positive correlations through the absence of significant correlation and were also subject to abrupt changes. The qualitative investigations supported these quantitative results by confirming that two different goal involvement states could either be opposite or concomitant. These findings provide additional insights into the debate about orthogonality (Harwood & Hardy, 2001; Harwood et al., 2000) vs. bipolarity (Treasure et al., 2001) of goal involvement states.

Given that these states can display different patterns of relationships de-

pending on time and situation, the question of these relationships can no longer be addressed in terms of general properties. Rather, we need to know under what circumstances some states of goal involvement display specific and momentary patterns of relationships. Regarding concomitance, data from the self-confrontation interviews revealed some information by pointing out the possible complementarity between the goals in terms of means-end relationships. Thus a mastery goal could have been adopted to achieve a performance-approach goal, and this latter goal could have been simultaneously seen as a relevant strategy for avoiding failure. Similar relationships of instrumentality among goals had already been suggested by Gernigon and le Bars (2000) concerning judokas' task and ego personal orientations.

The third purpose of the present study was to qualitatively examine the situational conditions of emergence of goals, using the situated-action analysis method (e.g., Theureau, 1992). Some initial conditions that were set through the coach's introductory words influenced the level of involvement toward goals. Thus the instructions to be flexible, to not resist, and to cooperate curbed participants' involvement toward performance-avoidance goals. Moreover, announcing that the entire session was devoted to practice combats made the participants save their strength and sometimes lower the intensity of their involvement toward any goal.

It could be assumed that the intent to respect these initial instructions may have resulted in a fixed-point attractor. A fixed-point attractor is a stable mode of behavior, or equilibrium point, to which the fluctuations of the variable capturing the dynamics of a complex system (i.e., the collective variable) asymptotically converge. However, given the above-mentioned high variability of the levels of involvement toward each goal, it is clear that goal involvement fluctuations did not converge toward any equilibrium point. Similar long-lasting oscillatory variations of social psychological variables such as social judgment have been observed by Vallacher et al. (1994), who explained this phenomenon by the contradictory roles of different attractors. In the present study, athletes' imaginary conversion of a flexible practice combat into an actual combat with the points being counted suggests the existence of possible ego-involving attractors that could have conflicted with the mastery-involving attractor represented by the initial conditions of the training session. The generally very ego-involving context of elite judo training (d'Arripe-Longueville, Fournier, & Dubois, 1998) and the typical ego orientation of high-level athletes (White & Duda, 1994) might have constituted such ego-involving attractors. As a result, individuals' attention can wander across attractive dispositional and environmental elements which may have contradictory goal-involving properties (Gernigon, d'Arripe-Longueville, Debove, & Puvis, 2003). Future research on the dynamics of goal involvement states should attempt to identify the combination of dispositional, contextual, and situational factors that could constitute attractors capable of stabilizing the levels of involvement toward the same goals.

The qualitative data pertaining to the situational conditions of goal activation suggest that changes in goal involvement mainly emerged from the course of action. The historicity of some events such as the outcomes of recent actions, the progression of imaginary scores, the opportunities of attack, the controllability of situations, and the situation-related feelings or emotions were found to arouse or undermine particular goal involvement states at given moments. These findings are consistent with Theureau's (1992) course of action theoretical framework.

According to Theureau, intentions emerge from present ecological constraints and are aroused within the immediacy of action. This ergonomic standpoint has already been taken up in sport regarding coach/athletes interactions during elite archery competitions (d'Arripe-Longueville et al., 2001). The ecological embedding of goal involvement explains why the activation of goals was found to be unplanned for the most part. A nice metaphor to illustrate the relative unpredictability of dynamical phenomena is that by Gleick (1987), which compares a dynamical behavior to a walk in a labyrinth whose walls move after each step.

One consequence of the ecological dependence of goal involvement is that any major determinant cannot be extracted in isolation from the numerous interacting elements of the complex system from which goals emerge. Rather, goal involvement states can be seen as embedded within the dynamical totality of actions-thoughts-emotions couplings. This is consistent with previous findings of research set in situated-action (e.g., Suchman, 1987) or based on the semiological framework of course of action (d'Arripe-Longueville et al., 2001; Sève et al., 2003). In these approaches, the activity and the situation determine each other through a circular process, and cognition is seen as indissociable from action, feelings, and experience, and closely linked to ecological constraints. There is no doubt that other types of variables could enrich the complexity of this totality. For instance, physiological factors such as physical exhaustion were not mentioned by the participants, but might have been reported if the combat had taken place near the end of the training session.

This study offers particular insights about the dynamics of goal involvement states in the sport domain. The present findings reveal that these states emerge and fluctuate according to the ecological constraints of the situations, undergo abrupt variations, and can develop all kinds of relationships between them. Given these highly dynamic properties, goal involvement clearly belongs to the range of phenomena whose behavior results from the complex interactions of the elements of a dynamical system.

One consequence of the dynamic nature of goal involvement states is the need for tools that can capture their ebb and flow. The present study provided an example of methodological innovation by combining quantitative and qualitative investigations. On the one hand, classical ANOVA and less known windowed cross-correlation analyses permitted the examination of variations in goal involvement states and in their patterns of synchronization. On the other hand, the situated-action analyses based on self-confrontation interviews supported the statistical findings and allowed the complexity of the situational conditions of activation of goals to be examined.

Further embracing a dynamical approach to study motivational states, as well as any transient sport-relevant psychological variable, will certainly urge researchers to seek appropriate tools. In particular, assessment procedures need to get closer to the action and be as noninvasive as possible, for instance through video recall methods as in the present study, or using short single-item questionnaires (Ninot, Fortes, & Delignières, 2001). Furthermore, examining the temporality of psychological processes is a primary purpose in the dynamical approach. Consequently, time series-appropriate statistical techniques whose use has been advocated for dynamical social psychology (e.g., Schroeck, 1994) could be adapted to the field of sport and exercise psychology in addition to the already used analyses with repeated measures.

The cost of having ventured into the dynamics of goal involvement can be translated into some methodological limitations. First, because taking part in a sport situation provides a unique and original experience for each individual, an idiosyncratic approach was particularly suited for examining the dynamics of goal involvement. This could limit the generalizability of the present findings. However, the more that such idiosyncratic studies are replicated, the more their findings (if consistent) will rise to the status of general laws.

Second, the present study is based on the hypothesis that goal involvement states can be consciously declared. We agree with Harwood et al.'s (2000) assumption that "it would perhaps be implausible for performers to consciously declare the conceptions of achievement that they hold at any moment in time" (pp. 251-252). However, because an achievement goal theory primarily addresses goals, we have to keep in mind that the concept of achievement that underpins any goal involvement is reflected by an intention. Our standpoint is that goal involvement can be assessed through intention, provided that items or qualitative data used to reflect an intention ensure its sense of achievement underpinning. Consequently, because such an intention is conscious and can be declared, goal involvement can be approached in a self-reported way with the support of an appropriate recall-facilitating procedure.

Third, the validity of the measurement of goal involvement needs more support. The consistency that was found between qualitative data and goal involvement graphs argues in favor of good reliabilities for both items and mouse paradigm. However, the theoretical validity of goal involvement items remains to be confirmed using experimental or correlational methods. Furthermore, because in the present study goal involvement states were assessed through the recall of short-term memories, testing the test-retest reliability of the video-assisted mouse paradigm was not relevant. Nevertheless, the stability of the results yielded by this procedure needs to be ascertained in further research. This could be done using repeated measurements upon standardized sport scenarios in which athletes would have to project themselves.

Typically, research on dynamical systems looks for abrupt qualitative changes in a given order parameter when the value of a control parameter gradually varies. According to dynamicians, an order parameter (or collective variable) is a qualitative pattern that accounts for the state of the system as a whole, whereas a control parameter is an external variable that influences this order parameter (e.g., Nowak & Vallacher, 1998). Because the present study was exploratory and was based on a natural sport situation, the collected quantitative data could not result from the controlled manipulation of any control parameter. Consequently, beyond the observed dynamic behavior of goal involvement states and of their patterns of synchronization, the potential status of order parameters of these variables remains to be established in regard to their sensitivity to control parameters. Such control parameters also need to be identified in future studies.

Future research aimed at further scrutinizing the dynamics of goal involvement states should seek the various dispositional, contextual, and situational factors that could attract their ebb and flow toward less erratic trajectories. From an applied perspective, the challenge would be to provide coaches and athletes with effective knowledge to adopt the most adaptive goal involvement according to the course of events. Besides this practical interest, the extension of the dynamical approach to other psychological variables could offer promising avenues of re-

search in the field of sport and exercise psychology. This approach will surely further the already significant advancement of research in the field. Indeed, according to Nowak and Vallacher (1998), "the dynamical approach should not be viewed as an alternative to more traditional approaches.... The methods spawned within this approach [i.e., traditional social psychological research] have been quite successful in identifying the key features of human thought and behavior. With the recent advent of the dynamical approach, it is now possible for investigators to assemble sets of such mechanisms into coherent systems" (p. viii).

References

- Boker, S.M., Xu, M., Rotondo, J.L., & King, K. (2002). Windowed cross-correlation and peak picking for the analysis of variability in the association between behavioral time series. *Psychological Methods*, 7, 338-355.
- Brislin, R.W., Lonner, W.J., & Thorndike, R.M. (1973). *Cross-cultural research methods*. New York: Wiley.
- Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.
- Cury, F., Elliot, A., Sarrazin, P., Da Fonseca, D., & Rufo, M. (2002). The trichotomous achievement goal model and intrinsic motivation: A sequential mediational analysis. *Journal of Experimental Social Psychology*, 38, 473-481.
- d'Arripe-Longueville, F., Fournier, J.F., & Dubois, A. (1998). The perceived effectiveness of interactions between expert french judo coaches and elite female athletes. *The Sport Psychologist*, 12, 317-332.
- d'Arripe-Longueville, F., Saury, J., Fournier, J., & Durand, M. (2001). Coach-athlete interaction during elite archery competitions: An application of methodological frameworks used in ergonomics research to sport psychology. *Journal of Applied Sport Psychology*, 13, 275-299.
- Duda, J.L. (2001). Goal perspective research in sport: Pushing the boundaries and clarifying some misunderstandings. In G.C. Roberts (Ed.), *Advances in motivation in sport and exercise* (pp. 129-182). Champaign, IL: Human Kinetics.
- Elliot, A.J. (1999). Approach and avoidance motivation and achievement goals. *Educational Psychologist*, 34, 169-189.
- Elliot, A.J., & Church, M.A. (1997). A hierarchical model of approach and avoidance achievement motivation. *Journal of Personality and Social Psychology*, 72, 218-232.
- Elliot, A.J., & McGregor, H.A. (2001). A 2 x 2 achievement goal framework. *Journal of Personality and Social Psychology*, 80, 501-519.
- Fortes, M., Delignières, D., & Ninot, G. (in press). The dynamics of self-esteem and physical self: Between preservation and adaptation. *Quality & Quantity*.
- Gernigon, C., d'Arripe-Longueville, F., Debove, V., & Puvis, A. (2003). Situational indexes of achievement motivation, help-seeking, and performance: Influences of the learning context and gender differences. *Research Quarterly for Exercise and Sport*, 74, 473-479.
- Gernigon, C., & le Bars H. (2000). Achievement goals in aikido and judo: A comparative study among beginner and experienced practitioners. *Journal of Applied Sport Psychology*, 12, 168-179.
- Gleick, J. (1987). *Chaos: The making of a new science*. New York: Viking-Penguin.
- Harwood, C., & Hardy, L. (2001). Persistence and effort in moving achievement goal re-

- search forward: A response to Treasure and colleagues. *Journal of Sport & Exercise Psychology*, **23**, 330-345.
- Harwood, C., Hardy, L., & Swain, A. (2000). Achievement goals in sport: A critique of conceptual and measurement issues. *Journal of Sport & Exercise Psychology*, **22**, 235-255.
- Harwood, C., & Swain, A. (1998). Antecedents of pre-competition achievement goals in elite junior tennis players. *Journal of Sports Sciences*, **16**, 357-371.
- Harwood, C., & Swain, A. (2001). The development and activation of achievement goals in tennis: I. Understanding the underlying factors. *The Sport Psychologist*, **15**, 319-341.
- Hauw, D., Berthelot, C., & Durand, M. (2003). Enhancing performance in elite athletes through situated-cognition analysis: Trampolinists' course of action during competition activity. *International Journal of Sport Psychology*, **34**, 299-321.
- Long, B.C., & van Stavel, R. (1995). Effects of exercise training on anxiety: A meta-analysis. *Journal of Applied Sport Psychology*, **7**, 167-189.
- Nicholls, J.G. (1984). Achievement motivation: Conceptions of ability, subjective experience, task choice, and performance. *Psychological Review*, **91**, 328-346.
- Nicholls, J.G. (1989). *The competitive ethos and democratic education*. Cambridge, MA: Harvard University Press.
- Ninot, G., Fortes, M., & Delignières, D. (2001). A psychometric tool for the assessment of the dynamics of the physical self. *European Journal of Applied Psychology*, **51**, 205-216.
- Nowak, A., & Vallacher, R.R. (1998). *Dynamical social psychology*. New York: Guilford Press.
- Roberts, G.C. (2001). Understanding the dynamics of motivation in physical activity: The influence of achievement goals on motivational processes. In G.C. Roberts (Ed.), *Advances in motivation in sport and exercise* (pp. 1-50). Champaign, IL: Human Kinetics.
- Schroeck, F.E., Jr. (1994). New mathematical techniques for pattern recognition. In R.R. Vallacher & A. Nowak (Eds.), *Dynamical systems in social psychology* (pp. 71-93). San Diego, CA: Academic Press.
- Seidman, I.E. (1991). *Interviewing as qualitative research: A guide for researchers in education and the social sciences*. New York: Teachers College.
- Sève, C., Saury, J., Ria, L., & Durand, M. (2003). Structure of expert players' activity during competitive interaction in table tennis. *Research Quarterly for Exercise and Sport*, **74**, 71-83.
- Smith, J.M.J., & Harwood, C.G. (2002). The transiency of goal involvement states within match-play: A case study of an elite athlete. *Journal of Sports Sciences*, **20**, 71-72.
- Suchman, L. (1987). *Plans and situated actions: The problem of human-machine communication*. Cambridge: Cambridge University Press.
- Swain, A.B.J., & Harwood, C.G. (1996). Antecedents of state goals in age-group swimmers: An interactionist perspective. *Journal of Sports Sciences*, **14**, 111-124.
- Theureau, J. (1992). *Le cours d'action: Analyse sémiologique. Essai d'une anthropologie cognitive située* [The course of action: Semiological analysis. Essay in situated cognitive anthropology]. Bern, Switzerland: Peter Lang.
- Treasure, D.C., Duda, J.L., Hall, H.K., Roberts, G.C., Ames, C., & Maehr, M.L. (2001). Clarifying misconceptions and misrepresentations in achievement goal research in sport: A response to Harwood, Hardy, and Swain. *Journal of Sport & Exercise Psychology*, **23**, 317-329.

- Vallacher, R.R., & Nowak, A. (Eds.) (1994). *Dynamical systems in social psychology*. San Diego, CA: Academic Press.
- Vallacher, R.R., Nowak, A., Froehlich, M., & Rockloff, M. (2002). The dynamics of self-evaluation. *Personality and Social Psychology Review*, **6**, 370-379.
- Vallacher, R.R., Nowak, A., & Kaufman, J. (1994). Intrinsic dynamics of social judgment. *Journal of Personality and Social Psychology*, **66**, 20-34.
- von Cranach, M., & Harré, R. (Eds.) (1982). *The analysis of action: Recent theoretical and empirical advances*. Cambridge: Cambridge University Press.
- White, S.A., & Duda, J.L. (1994). The relationship of gender, level of sport involvement, and participation motivation to task and ego orientation. *International Journal of Sport Psychology*, **25**, 4-18.

Notes

¹ Further refinements of Elliot and colleagues' conceptualization led to the consideration of a 2×2 achievement goal framework comprising mastery-approach, mastery-avoidance, performance-approach, and performance-avoidance, and even a 3×2 framework in which intrapersonal (past-referenced) and absolute (task-referenced) mastery goals could be distinguished for both mastery-approach and mastery-avoidance goals (Elliot & McGregor, 2001). These refinements were not used in the present study because the trichotomous framework is the one that most crosses the major achievement goal theories (e.g., Nicholls, 1989), and has the best differential predictive utility, even though avoidance-performance goals were not considered as a variable to be measured in the empirical tests of these theories.

² TFT: Thin film transistor. This type of screen was chosen because of its greater definition of image compared to more traditional screens.

³ Although the performance-avoidance graph was higher than the performance-approach graph, no conclusion can be drawn from the graphs only as to the dominant focus at a given time, since the absence of available norms of goal scores precludes any comparison among different goals.

⁴ The point counting system used in judo competition includes four kinds of advantages which are designated by the Japanese words *Koka*, *Yuko*, *Waza-ari*, and *Ippon* (from lowest to highest).

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