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Exerted Effort and Performance in Climbing Among Boys: The Influence of Achievement Goals, Perceived Ability, and Task Difficulty

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In achievement contexts such as sport, achievement goal theory assumes that an individual's major concern is to demonstrate competence. However, competence may be expressed in two ways: as task and ego involvement (Nicholls, 1989). Seventy-eight boys (M age = 13.6 years) performed five climbing courses, and the influence of achievement goals, perceived ability, and task difficulty on effort and performance was studied. According to the achievement goal theory: (a) task-involved boys exerted more effort and performed better than ego-involved boys; and (b) exerted effort was determined by an interaction of one's achievement goal, perceived ability (PA), and task difficulty. Ego-high PA boys and task-low PA boys exerted the most effort on the moderate course; ego-low PA boys exerted least effort on the moderate and very difficult courses. Finally, task-high PA boys exerted more effort on the most difficult courses. The motivational processes underlying these findings are discussed.

Key words: ego goals, motivation, task

Exerted effort, or behavioral intensity, particularly in the face of obstacles, is considered an indication of motivation (Duda, 1992; Kukla, 1972; Maehr & Braskamp, 1986; Nicholls, 1984, 1989; Roberts, 1992). In sport, effort is also considered a major factor in performance. Consequently, it is important to study personal and contextual variables that might regulate exerted effort. The purpose of this paper was to investigate variables that regulate effort by using the social-cognitive model of achievement motivation widely used in contemporary sport and educational psychologies—the achievement goal approach (e.g., Roberts, 1992; Weiner, 1990).

Achievement goal theory has been used extensively in education (e.g., Ames, 1992; Dweck, 1986, 1999; Dweck & Legett, 1988; Maehr & Braskamp, 1986; Nicholls, 1984, 1989) and in sport and physical education (for reviews see, Duda, 1992, 2001; Roberts, 1992, 2001; Roberts, Treasure, & Kavussanu, 1997). This approach assumes: (a) that the goal of individuals is to demonstrate competence in achievement contexts; and (b) that at least two achievement goals are operating in these contexts (Ames, 1992; Duda, 1992; Dweck, 1986, 1989; Maehr & Braskamp, 1986; Nicholls, 1984, 1989; Roberts, 1992; Roberts et al., 1997). Nicholls (1984, 1989) proposed that these goal perspectives are related to how individuals construe their competence level in achievement situations. His research showed that the perception of competence may come from two types of experiences, each linked to distinct criteria and processes (i.e., an undifferentiated versus a differentiated conception of ability).

Within Nicholls' theoretical perspective, each conception of ability is assumed to manifest itself through two states of goal involvement. In the first case, the individual's goal is to master tasks, solve problems, per-

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form one's best, and experience personal improvement. The feeling of competence lies in self-referenced criteria, such as effort investment and personal progress, and a process of temporal comparison. Although several terms have been used, "task involvement" (Nicholls, 1989, p. 87) is the one adopted here for this achievement goal. A state of task involvement exists when individuals hold an undifferentiated conception of ability, where ability and effort "walk hand in hand" (Duda, 2001). *When effort is applied, feelings of competence* will increase (Nicholls, 1989).

In the second case, both demonstrating one's high ability and avoiding demonstration of comparative low ability are of major concern. Here, the feeling of competence depends on external criteria (the performance and effort of others) and a process of normative comparison to others. Although several terms have been used, "ego involvement" (Nicholls, 1989, p. 87) is the one adopted here for this achievement goal. An ego state of involvement exists when individuals hold a differentiated conception of ability, and where "ability is conceived as capacity, which (if low) may limit or (if high) may increase the effect of effort on performance" (Nicholls, 1989, p. 46). Moreover, with this conception, achieving more with less effort than others indicates higher ability, and, reciprocally, achieving less with more effort than others indicates lower ability.

Whether one is task or ego involved is based on the interaction between dispositional goal orientations and situational factors (Duda, 2001; Roberts, 2001). Goal orientations are considered to be "individual differences in proneness to the different types of involvement" (Nicholls, 1989, p. 95). They are "cognitive schema" (Roberts et al., 1997), relatively stable and orthogonal (Nicholls, 1989), and are subject to change as information pertaining to one's performance on the task is processed. Research in sport and physical education settings has supported this (see Duda, 1992, 2001; Duda & Whitehead, 1998; Roberts, 1992, 2001).

Although proneness can make a particular type of involvement more likely, both Dweck (1986, 1999) and Nicholls (1984, 1989) argued for the importance of situational factors in inducing states of ego or task involvement. For example, Nicholls (1984, 1989) hypothesized that ego involvement is more likely to be generated when the tasks (*especially* if they require valued abilities) are shown as tests, in situations of interpersonal competition or comparison, or when public self-awareness is increased. By contrast, task involvement is more likely to be generated by contexts that do not heighten self-awareness of social evaluation but enhance the learning process, the mastery of tasks adapted to individual levels, investment, and progress. Nicholls and Dweck referred to features of the objective environment; Ames (1992), however, pointed to the importance of people's *perceptions* of situational structures. She used the term "perceived motivational climate" to refer to individuals' composite appraisal or views concerning the situationally emphasized goal structures operating in a specific achievement setting.

To date, research has primarily examined the motivation-related correlates of goal orientations and perceptions of the motivational climate in isolation (for reviews, see Duda, 2001; Roberts, 2001; Roberts et al., 1997). However, the major achievement goal theorists and, in particular, Dweck (1999; Dweck & Leggett, 1988) suggested that an interactionist approach that combines both dispositional orientations and perceptions of the climate promises to provide a more complete understanding of achievement behavior. Indeed, one can easily imagine situations in which these two variables are compatible and others in which the personal tendency conflicts with the situational factors (Roberts, 1992). As a result, research in sport and physical education has begun to investigate the relative contribution of each on motivational variables (e.g., Swain & Harwood, 1996; Treasure & Roberts, 1998; see Duda, 2001, for a review).

When the situation structure matches with the individual tendency, one can speculate that the individual will pursue his or her preferred goal in an idiosyncratic manner. It is the "matching hypothesis" (see Duda, 2001). Contrarily, when the motivational climate values criteria of success and failure that are incompatible with the tendency of the individual, a conflict may occur, either causing the individual to reflect the achievement criteria of success within the context or ignoring the achievement criteria in the context to make it fit better with the individual's dispositional tendency (Roberts, 1992; Roberts et al., 1997). However, in the present study, we were not interested in the relative contribution of the dispositional tendency and the motivational climate. Rather, we took pains to match the goal orientation with the relevant climate to investigate the impact of being task or ego involved on the variables of interest to the present investigation.

A final point of agreement of the major achievement goal theorists concerns the proposed interrelationships between achievement goals and behavior. According to Nicholls (1989, p. 106), the predictions related to individuals' motivation rest on "an adequate description of what individuals will want, in conjunction with a description of their understanding of what they might do to get what they want." In other words, knowing the individuals' goal in a given situation (ego versus task) and what they should do to achieve this goal puts us in a better position to predict their behaviors, namely, effort and achieved performance in this study. Where individuals are assigned tasks of different difficulty levels, exerted effort and performance depend on the goal adopted in interaction with other cognitive variables, such as per-

ceived ability and task difficulty (Dweck, 1986, 1999; Dweck & Leggett, 1988; Nicholls, 1984, 1989).

When individuals are task involved, their purpose is to learn something new or master the task or activity. The amount of effort they exhibit depends on their belief of their ability to make progress on the task (Nicholls, 1989). Effort should be lower, if individuals believe little effort is needed for success or high effort will be fruitless. By contrast, it is assumed that people commit themselves more to a task if it appears to be challenging, requires effort to succeed, and success or failure is uncertain (i.e., when task difficulty is perceived to be at an intermediate level for the person or when the subjective perception of success is thought to be "moderate"). This is when personal challenge is maximized. Perceived normative ability is assumed to be irrelevant to a task-involved person (Nicholls, 1989; Roberts, 1992); however, perceived ability is hypothesized to affect the perceived difficulty of the task that affects exerted effort (Nicholls, 1989). As people vary in the level of task difficulty at which they expect gains in mastery (i.e., the people who are high in ability consider that difficult tasks are challenging, while the people low in ability estimate that easier tasks are challenging), they vary in the level of difficulty at which they exert more effort. Consequently, as Table 1 indicates, it is hypothesized that the greatest effort is exerted at the moderate and difficult task levels for task-involved people with high perceived ability and at the easy and moderate task difficulty levels for task-involved people with low perceived ability (Nicholls, 1984, 1989).

When individuals are ego involved, assessments are more complex. Their goal is to appear better than the norm and avoid demonstrating comparatively low ability. Ideally, ego-involved individuals wish to appear better with the least effort possible. Consequently, they will apply high effort only if they believe it is necessary to establish that their capacity is high. However, with an ego goal, effort may be a "double edged sword:" One needs it to succeed, but failure with high effort can demonstrate incompetence (Covington, 1992; Covington & Omelich, 1979; Dweck, 1999). As it is possible to avoid demonstrating incompetence if failure can be attributed to not trying hard, it is hypothesized that ego-involved individuals do not exert effort when convinced that an investment in effort does not enable them to establish their superiority over others.

Ultimately, the effort people exert depends both on their perceived ability and on cues related to the normative difficulty of the task. People who believe they have high ability expect to demonstrate superiority over most of their peers. To achieve this goal, they try hard and perform well on tasks where success demonstrates high ability (i.e., tasks perceived as normatively moderate and difficult). In contrast, they exert little effort on normatively easy tasks, as they are sure to achieve success, or on tasks perceived to be so difficult that failure appears certain. Table 1 illustrates these hypotheses formulated by Nicholls (1984, 1989).

Persons who regard themselves as below the norm in ability expect to fail when they are confronted with tasks of moderate normative difficulty. With such a level of difficulty, achievement striving is more "diagnostic" of a person's ability level, insofar as success indicates high ability and failure indicates low ability. Therefore, they anticipate demonstrating a lack of ability. If they cannot escape from such an aversive task, they will apply little effort to avoid decisive evidence of their incompetence and perform poorly (Jagacinski & Nicholls, 1984). Exerting low effort in this case is a strategy meant to protect self-worth (Covington, 1992; Covington & Omelich, 1979; Dweck, 1999; Frankel & Snyder, 1978). These people see normatively easy or difficult tasks as an opportunity to conceal evidence of low ability. They will work hard on normatively easy tasks where failure, which would indicate incompetence, appears to be avoidable with effort. On the other hand, when a task is seen as normatively difficult, great effort allows one the opportunity to demonstrate high ability (success at a difficult task), while failure may be rationalized by the difficulty of the task. In summary, ego-

Table 1. Contrast codes for exerted effort in each group as a function of task difficulties

Involvement	Perceived ability	Difficulties of the course: Very easy	Easy	Moderate		Difficult	Very difficult
Task	High	- 2	- 2	+ 3	+ 1	+ 3	- 2
Task	Low	- 2	+ 3	+ 3	+ 1	- 2	- 2
Ego	High	- 2	- 2	+ 3	+ 1	+ 3	- 2
Ego	Low	+ 2	+ 2	- 3	**- 3**	+ 2	- 3

Note. The minus sign (-) means that low exerted effort is hypothesized, whereas the plus sign (+) means that high effort is hypothesized. Five contrasts (or hypotheses) are tested: four within participants (horizontal columns) and one between participants (in bold face type).

involved individuals with low perceived ability try hard on normatively easy and difficult tasks and exert little effort on normatively moderate tasks or tasks perceived to be so difficult that failure appears certain (see Table 1).

In the academic domain, Nicholls (1984, 1989) found some indirect evidence supporting his hypotheses by reinterpreting results of research carried out in other theoretical frameworks (e.g., Frankel & Snyder, 1978; Kukla, 1972; Miller, 1985; Sarason, 1975). In the physical realm, as Duda (1992) stated, "Although behavioral intensity is not an easy variable to operationalize, much more work on the interdependence between goals and exerted effort is needed" (p. 75). To date, the few studies conducted on this topic within the frame of achievement goal theory are essentially correlational in design. These studies have demonstrated the associations between the two dispositional achievement goals and the motivational climate and different indexes of behavioral intensity. These indexes have been the number of hours of sport activities per week (Duda, 1988), the effort of athletes as assessed by their coaches (Duda, Smart, & Tappe, 1989), the perceived effort exerted by athletes (Cury, Biddle, Famose, Goudas, Sarrazin, & Durand, 1996; Duda & Nicholls, 1992; Durand, Cury, Sarrazin, & Famose, 1996; Goudas, Biddle, & Fox, 1994; Tammen, Treasure, & Power, 1992), persistence after failure (Cury, Biddle, Sarrazin, & Famose, 1997), the number of trials per minute in a difficult or moderately difficult task choice (Solmon, 1996), and, more generally, persistence and attrition in sport activities (for reviews, see Duda, 1992, 2001; Roberts, 1992; 2001; Roberts et al., 1997). In general, previous research has shown that: (a) when people are task oriented or in a task-involving climate, they exhibit (or report) greater effort than others (e.g., Cury et al., 1996; Duda, 1988; Duda & Nicholls, 1992; Duda et al., 1989; Durand et al., 1996; Goudas et al., 1994; Solmon, 1996; Tammen et al., 1992); and (b) when people are ego oriented or in an ego-involving climate, those with low perceived ability exhibit reduced exerted effort as opposed to those with high perceived ability and task-oriented people (e.g., Cury, Biddle, et al., 1997).

However, to our knowledge, no research has been conducted within the achievement goal approach to directly test Nicholls' hypotheses relating to exerted effort when the difficulty of the task is controlled and the level of perceived ability is measured. The purpose of this study, therefore, was to investigate the effects of these three variables on performance and exerted effort among boys on a motor task of climbing. Based on achievement goal theory and past research, the following hypotheses were tested.

First, an achievement goal main effect was presumed. More precisely, task-involved participants were expected to exert more effort and perform better than ego-involved participants. For those endorsing a task goal, there is a fundamental belief that ability and effort covary (Ames, 1992; Dweck, 1999; Nicholls, 1989) so that when effort is applied, competence will increase. Consequently, these individuals tend to try hard and be more persistent when faced with obstacles and difficulty, thus, optimizing their task performance. By contrast, those who hold an ego goal are less likely to consider effort to be an important cause of success. Rather, they tend to believe that success primarily stems from the possession of comparatively high ability (e.g., Sarrazin et al., 1996). Moreover, as they are preoccupied about whether their ability is adequate, they are more inclined to reduce effort to avoid demonstrating incompetence, thus, maximizing their chances of impaired performance.

Second, an interaction between achievement goals, perceived ability, and task difficulty was presumed. The implications of this interaction on exerted effort are displayed in Table 1. Task-involved participants with high perceived ability were expected to exert greater effort on moderately difficult and difficult tasks than on the other tasks; task-involved participants with low perceived ability were expected to exert greater effort on easy and moderately difficult tasks than on the other tasks; ego-involved participants with high perceived ability were expected to exert greater effort on moderately difficult and difficult tasks than on the other tasks; ego-involved participants with low perceived ability were expected to exert less effort on moderate and very difficult tasks than on the other tasks. For these four hypotheses, there are no specific predictions for the performance reached by the participants because of the performance specificity in the sport field. In the predictions of Nicholls (1984, 1989), performance is synonymous with effort (i.e., high effort involves high performance, and the converse) in that the experimental tasks (intellectual) are of relatively short duration and provide only dichotomous, success-or-failure information. In climbing (and in most sports in general), the achievement endeavor can last for many minutes so that successes and failures are affected by many variables in addition to effort (e.g., ability, difficulty, context, anxiety, luck, etc.). Thus, an individual can exert much effort and fail to achieve the desired level of outcome or, conversely, can exert little effort and achieve the desired level of outcome. Consequently, individuals can be expected to do well with little effort (on the easy tasks) and fail despite great effort (on the difficult tasks).

Last, it is expected that, on the average normative difficulty task, ego-involved participants with low perceived ability exert less effort and perform worse than ego-involved participants with high perceived ability and task-involved participants. This level of difficulty is more averse for the low ability ego-involved group, because it is the most "diagnostic" of the ability levels, and they expect

to fail. By contrast, ego-involved participants with high perceived ability perceive this difficulty level as allowing them to demonstrate their ability. Further, this level of difficulty is challenging for most task-involved participants.

Method

Participants

Boys (N = 500) from a suburban school near a large town in France, largely of high socioeconomic status, volunteered to answer two questionnaires at the beginning of the year. One month later, 78 of them were selected on the basis of their perceived ability and individual orientations, according to the procedures explained below. They were 12–16 years old (M = 13.6 years, SD = 1.6) and had been practicing climbing for at least 1 year as part of sport classes in the school, but they did not know the courses to climb used in this investigation[1]. Parental permission was requested before starting the investigation.

Task

The task was to climb five 8-m high courses using mountain climbing techniques. The normative difficulties had been established beforehand with 100 boys of the same age: 94% succeeded in the first course, which was termed "very easy," 80% in the second, which was termed "easy," 54% in the third, which was termed "moderate," 23% in the fourth, which was termed "difficult," and 3% in the fifth, which was termed "very difficult."

Measures

Dispositional Goal Orientations. To assess the boys' ego and task goal orientations in sport, the French version of the Perception of Success Questionnaire (POSQ) developed by Roberts and associates (Roberts, Treasure, & Balague, 1998, Treasure & Roberts, 1994) and validated in France by Durand et al. (1996) was used. When completing the POSQ, participants were requested to think of when they felt most successful in sport and respond to the six task goal orientation items (e.g., "I master something I could not do before"), and the six ego goal orientation items (e.g., "I outperform my opponents"). Responses were indicated on a 5-point Likert scale anchored by "strongly disagree" (1) and "strongly agree" (5). Cronbach alpha coefficients for the task and ego subscales in the present study were .78 and .89, respectively. Moreover, the two subscales were independent (r = -.02, p > .05). This is consistent with prior research (e.g., Cury et al., 1996; Cury, Sarrazin, & Famose, 1997; Duda & Whitehead, 1998; Durand et al., 1996; Roberts et al., 1998, Treasure & Roberts, 1994; Sarrazin et al., 1996).

Perceived Ability in Climbing. To assess perceived climbing ability, a 4-item questionnaire similar to the one developed by Nicholls and colleagues (Duda & Nicholls, 1992; Nicholls, Patashnick, & Nolen, 1985) was used (e.g., "when you practice climbing and compare yourself to most of your fellow students, you consider yourself ..."). Responses were indicated on an 11-point scale ranging from "very bad" (1) to "very good" (11), with the middle point corresponding to "moderate" (6). In previous research conducted on teenagers, the questionnaire has shown good construct validity, internal consistency, and predictive validity (Cury, Biddle, et al., 1997; Cury et al., 1997). In this study, the internal consistency was high (α = .88).

Situationally Induced Motivational Goal. After the sessions, pupils rated two statements portraying a task-involving context (i.e., "In your opinion, can we say that the purpose of this session is a private climbing lesson with the aim of progressing in that activity") and an ego-involving context (i.e., "In your opinion, can we can say that the purpose of this session is to rate each of the participants against each other in relation to their climbing level"). The answers were indicated on an 5-point scale anchored by "strongly disagree" (1) and "strongly agree" (5).

Effort. In this study, effort was conceptualized as the momentary maximal level of energy resources provided by the participant to climb each course. As there is a linear relation between the intensity of work and heart rate (e.g., Astrand & Rodahl, 1986), the maximum heart rate (MHR) reached in each climb constitutes an accepted physiological index of exerted effort (for use of this physiological index, see Wright & Kirby, 2001). The heart rate was recorded continuously with an ambulatory device (cardiofrequency meter BHL-5000, Bauman, Fleurier, Switzerland). The BHL-5000 is a lightweight instrument strapped on a belt linked to the participant by three electrodes on the chest. It is equipped with a microprocessor that measures the time lapse between two heartbeats with millesimal second precision. The data were recorded by the program provided with the instrument (Ancarr, Fleurier, Switzerland). For each climb, the MHR reached at the top of an exponential curve during one period covering several tens of seconds was stored. This progressive curve is indicative of incremental energy needs. To consider the differences in fitness and age among participants, the percentage of the heart rate reserve (HRR) reached during each course was used. HRR is the difference between predicted MHR and the resting heart rate (RHR; assessed during a 10-min baseline before the experiment). Predicted MHR was estimated by applying the classic 220-minus-age formula (e.g., Astrand & Rodahl, 1986). To

summarize, for each course the following formula was used to calculate the momentary effort in term of the heart rate reserve percentage:

$$[(MHR - RHR)/(220 - age - RHR)] * 100.$$

Performance. In this study, performance was operationalized as successfully completing each climbing course (i.e., whether they made it to the top or not), whatever the number of attempts and the time required to complete.

Procedure

Taking into account the difficulty in measuring the individuals' involvement (see Duda & Whitehead, 1998), the main purpose of the procedure was to maximize the likelihood of individuals adopting the achievement goal required. Because the goal pursued by an individual results from the interaction of situational and dispositional factors (see above), this raises methodological issues. When the motivational context portrays a goal not congruent with the individual's dispositional tendency, a conflict may occur, and under these conditions it becomes difficult to control the achievement goal adopted by the individual. Moreover, the orthogonality of the goal orientation construct makes the control especially complicated (Duda, 2001). What state of involvement will individuals adopt who are high ego and high task oriented? Facing these constraints, it has been deemed preferable to: (a) determine the "goal profiles" (Duda, 2001; Fox, Goudas, Biddle, Duda, & Armstrong, 1994) of individuals and retain only participants who are "high" ego oriented and "low" task oriented on the one hand and "high" task oriented and "low" ego oriented on the other; (b) place the participants in a context conforming to their motivational profile (i.e., a high ego/low task participant was placed in a context inducing ego involvement, and a high task/low ego participant was placed in a context inducing task involvement) so as to reinforce the dispositional aspect and optimize the likelihood of individuals adopting the desired goal, in accordance with the matching hypothesis; and (c) check that the participants perceived the context as it was manipulated. The effectiveness of this procedure has been demonstrated by other research (Cury, Biddle, et al., 1997; Cury et al., 1997). Nevertheless, it should be noted that we do not directly measure the goal states, but, similar to previous research, we infer them from conditions that maximize their probability of appearance. For reasons of convenience and conceptual consistency we will speak of task or ego "involvement" throughout this paper, although involvement was not truly assessed.

To formulate the goal profiles, the percentile distribution for each subscale of the questionnaire assessing the dispositional goal orientations in sport was used. The boys were classified "high" in one orientation, when they were in the highest third of the distribution, and "low," when they were in the lowest third of the distribution of the other orientation. In addition, groups were split according to the scores on the perceived climbing ability scale. Pupils were classified as high in ability when their mean score was greater than 6—the scale midpoint—while low ability was indicated by a score of less than 6. As a result, 4 groups were created:

1. A high task-orientation, low ego-orientation group with high perceived ability (called Task+; $n = 20$)
2. A high task-orientation, low ego-orientation group with low perceived ability (called Task-; $n = 18$)
3. A high ego-orientation, low task-orientation group with high perceived ability (called Ego+; $n = 20$); and
4. A high ego-orientation, low task-orientation group with low perceived ability (called Ego-; $n = 20$).

With permission from the teachers, the researcher called for the boys during their physical education class and took them to the climbing wall inside the gymnasium. Under the pretext of checking the students' health, the boys were given a cardiofrequency meter strapped on a belt, and their heart rate was monitored continuously throughout the experiment, during the initial rest period until the end of the session. The boys were faced with climbing the five courses offered to them. They had to begin with the average difficulty course; afterward, the order of climbs was drawn at random. They were reminded of the normative difficulty of the courses before each climb. All the boys had as much time and as many attempts as they wanted to climb each course. The experimenter never referred to a time limit, and the participant chose when he wanted to change course. To lessen the effect of fatigue, a rest period of at least 10 min was arranged between each climb.

A trained experimenter experienced in teaching styles, pedagogy, and climbing techniques manipulated the motivational climate. He was blind both to the exact purpose and hypotheses of the study and to the participants' level of perceived ability. Several preparatory meetings and pilot testing were necessary to develop and control manipulation of the two contexts. In the context inducing task involvement, the participants were told it was a private climbing lesson to develop their ability in that activity, and to achieve that end they were going to try climbing five different courses. The experiment was conducted without onlookers and in the absence of the class teacher. When a boy "fell," the experimenter said in a neutral voice, "In your climb, you have used [such and such] a hold [that he illustrated], and you have not been able to clear the obstacle; can you do it differently? Have you seen all the holds?" In order not to induce social desirability, the experimenter did not encourage the

participant and regularly reminded him that he could quit whenever he liked and go on to the next course.

In the context inducing ego involvement, the participant was told that he was going to take part in a climbing competition with other students of the same age, a competition that would classify him according to his results. Each course was given a number of points (from 1 for the easiest to 5 for the most difficult). In case of failure, no point was scored. Each participant was tested individually; filmed on video, and told at the end of the test that all the participants could view the records and the overall placing would be announced publicly. The experimenter delivered no encouragement or reprimand.

After the session, each pupil was asked to evaluate his perception of the goal induced by the context. To minimize any negative effects and properly debrief the boys, the results of the climbs were not revealed. In addition, during a posttest meeting (1 week after the end of the study), a full debriefing was conducted and the full objectives of the investigation and the nature of the results were outlined.

Data Analysis

The MHR indexes were collected from the experimenters' recordings. A physical activity physiology expert analyzed 100 recordings selected at random from the sample. The indexes collected by the expert and the experimenters were very highly correlated ($r = .99$; $p < .001$).

The manipulation checks were analyzed using two t tests with goal condition (ego vs. task) as the independent variable and the treatment condition as the dependent variable. To control for Type-I errors, the Bonferroni method was used to determine the significance level, $\alpha / p = .025$ (e.g., Bray & Maxwell, 1985). The hypotheses relating to performance were tested using chi-square tests. For the percentage of the HRR data, a 2 (involvement) x 2 (perceived ability) x 5 (task difficulty) analysis of variance (ANOVA) was conducted, with repeated measures on the difficulty variable. Finally, planned comparisons (contrast analyses) were used to test specific hypotheses (Table 1 shows the contrast codes used to test them). With the Bonferroni method, the significance level was adjusted to $\alpha / p = .01$.

Results

Manipulation Checks

Participants placed in the task-involved condition ($M = 4.82$) reliably perceived the purpose of the session as "a private climbing lesson with the aim of progressing in that activity" more than those in the ego-involved condition ($M = 1.35$), $t(76) = -29.24$, $p < .0001$. Conversely, participants placed in the ego-involved condition ($M = 4.83$) reliably perceived the purpose of the session as a way "to rate each of the participants against each other in relation to their climbing level" more than those in the task-involved condition ($M = 1.13$), $t(76) = 44.69$, $p < .0001$. These results confirmed the validity of the experimentally induced motivational context.

Performance

On the five courses as a whole, a chi-square test showed that the distribution of success or failure as a function of task or ego involvement deviated from theoretical distribution, χ^2 (1, $N = 390$) = 12.63, $p < .001$. The task-involved participants obtained more success than the ego-involved participants (60% versus 42%).

A second chi-square test showed that the distribution of success or failure as a function of the Group x Difficulty (i.e., 20 subgroups) deviated from theoretical distribution, χ^2 (19, $N = 390$) = 262.30, $p < .0001$. The analysis of the post hoc cell contributions to the chi-square (i.e., computation of adjusted residuals) revealed that the Task+ and Ego+ groups experienced significantly (> 1.96) more success on the very easy and easy courses and more failures on the very difficult course, but the Task+ participants succeeded more on the moderately difficult and difficult courses than the Ego+ participants: 100 versus 70%, and 60 versus 30%, respectively. The Task- and Ego- groups experienced significantly more success on the very easy course and more failures on the difficult and very difficult courses, but the Task- participants succeeded more on the easy and moderate courses than the Ego- participants: 89 versus 35% and 44 versus 0%, respectively. The Ego- group is the only one that failed significantly more on the average course. Table 2 presents the success rate according to group and difficulty of the course.

Effort

ANOVA of the percentage of the HRR data showed a main effect for involvement, $F(1, 74) = 6.80$, $p < .012$, $\eta^2 = .08$. Regardless of perceived ability and task difficulty, task-involved boys exerted more effort than ego-involved boys (73.43 vs. 68.37%). Results also revealed a significant Involvement x Perceived Ability x Task difficulty interaction, $F(4, 296) = 2.90$, $p < .03$, $\eta^2 = .04$. The effort exerted according to difficulty of the course was different depending on group membership (see Figure 1). In accordance with Table 1, contrast analyses revealed that: (a) the Ego+ participants exerted more effort on the moderate and difficult courses than on the very easy, easy, and very difficult courses, $F(1, 74) = 13.78$, $p < .001$, $\eta^2 = .16$; (b) the Ego- participants exerted less effort on the moderate and very difficult courses than on the very

easy, easy, and difficult courses, $F(1, 74) = 42.18$, $p < .0001$, $\eta^2 = .36$; (c) the Task- participants exerted more effort on the easy and moderate courses than on the very easy, difficult, and very difficult courses, $F(1, 74) = 6.39$, $p < .01$, $\eta^2 = .09$; and (d) the Task+ participants did not exert more effort on the moderate and difficult course than on the very easy, easy, and very difficult courses, $F(1, 74) = 4.00$, $p > .01$, $\eta^2 = .05$. As shown on Figure 1, exerted effort by this group is a linear function of the difficulty, $F(1, 74) = 22.24$, $p < .0001$, $\eta^2 = .23$, the higher the difficulty, the higher the exerted effort. Finally, the Ego- participants exerted less effort than the three other groups on the average difficulty course, $F(1, 74) = 22.52$, $p < .0001$, $\eta^2 = .23$.

Discussion

The purpose of this study was to determine whether the effort exerted by boys performing a climbing task was influenced by the achievement goal (task or ego), perceived ability at the task (high or low), and task difficulty. Although effort is not an easily operationalized variable (Duda, 1992), the measure chosen was the percentage of the HRR (i.e., the percentage of the possible MHR of each individual taking into account his RHR and his age) based on the intimate bonds that exist between cardiovascular responsivity and effort (see for a review, Wright & Kirby, 2001).

In support of the first hypothesis, this study showed that boys placed in a condition maximizing the probability that they would adopt a task-involved goal, exerted more effort and obtained more success than boys placed under a condition maximizing the probability that they would adopt an ego-involved goal. This finding is consistent with former studies using other criteria of effort (Cury et al., 1996; Duda, 1988; Duda & Nicholls, 1992; Duda et al., 1989; Durand et al., 1996; Goudas et al., 1994; Tammen et al., 1992) and other operational definitions of performance (e.g., Theebom, De Knop, & Weiss, 1995). It can be explained by the fact that when endors-

Table 2. Number of successes according to group and difficulty of the course

Group	*N*	Difficulties of the course				
		Very easy	Easy	Moderate	Difficult	Very difficult
Task						
PA+	20	20	20	20	12	1
PA-	18	17	16	8	0	0
Ego						
PA+	20	20	19	14	6	1
PA-	20	16	7	0	1	0

Note. PA = perceived ability; + = high; - = low.

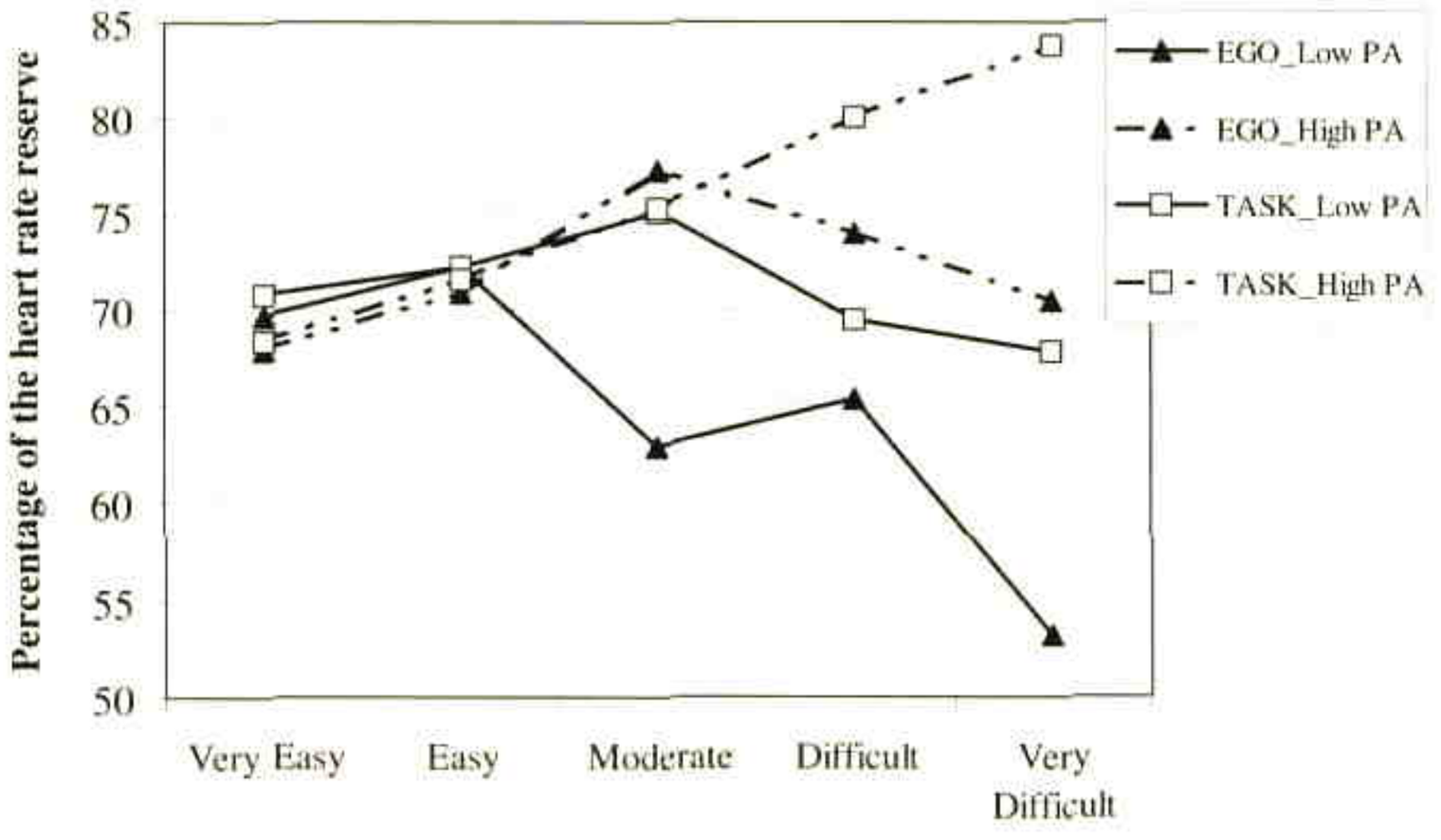

Figure 1. Percentage of the heart rate reserve, according to group and difficulty of course.

ing a task goal, there is a fundamental belief that ability and maximum effort covary (Ames, 1992; Dweck, 1999; Nicholls, 1989). Moreover, a lack of success on the difficult tasks is not viewed as a reflection of the inadequacy of oneself, rather it causes persistence in striving for achievement (e.g., Cury, Biddle, et al., 1997). Thus, it is entirely reasonable for task-involved people to exert effort and experience more success. When endorsing an ego goal, however, there is an inverse proportional relationship between effort and ability. This means that success with little effort is particularly desired (as it is evidence of high ability), and failure with high effort is particularly undesirable. Thus ego-involved people are less likely to try harder than task-involved people, as was demonstrated in the present investigation. But the interaction effects suggest that this is more complex.

Indeed, consistent with the tenets of achievement goal theory (Nicholls, 1984, 1989), the important finding in the present study is that exerted effort was determined by an interaction between one's achievement goal, perceived ability, and task difficulty. The task-involved boys exerted the most effort at a level of difficulty according to their perception of ability. The Task- group exerted most effort on the easy and moderate courses, whereas the Task+ produced most effort on the higher difficulty levels. When task involved, and progress and mastery were sought, the boys exerted the most effort on difficulty levels they considered "challenging," given their own capabilities. That is why the boys with high perceived ability exerted the most effort at the higher difficulty levels than the boys with low perceived ability.

Because Task+ boys exerted the most effort on the most difficult courses, the hypothesis may be posited that for them the relationship between task difficulty and exerted effort is linear, as suggested by goal-setting theory (Locke, 1968; Locke & Latham, 1985). Goal-setting theory suggests that the lower the chances of success, the higher the effort. Other experiments controlling the subjective probabilities of participants' success seems to be necessary to verify this hypothesis. However, this finding is not inconsistent with achievement goal theory when one recognizes that the Task+ boys were not trying to demonstrate superiority but merely to demonstrate task competence. Hence, these boys recognized that the most difficult courses required more effort to demonstrate mastery of the task, even though the number of boys succeeding decreased (see Table 2). It would appear that these boys tended to be optimistic about success and maintained effort even when the level of difficulty was very high, as Dweck (1999) hypothesized.

Consistent with our hypothesis, the boys from the Ego+ group exerted the most effort on the moderate and difficult courses, significantly more than on the very easy, easy and difficult courses. When individuals want to demonstrate superiority over others and are convinced they are able to do so (i.e., high perceived ability), then they feel they must succeed at tasks where the level of difficulty reveals above average ability. Therefore, high effort is particularly needed when one is facing the latter. This is what we found in the present investigation. Nevertheless, this need to demonstrate superiority to others can lead to failure. Even though the performance (climb success rate) remained higher than the average success rate on this course, as revealed previously in the pilot study with a group of 100 boys, 30% of the Ego+ participants failed on the moderate task, whereas all the Task+ participants succeeded at this difficulty level (see Table 2). Why this is the case is an interesting issue to debate. Perhaps by being concerned about one's standing relative to others, this may lead to partial withdrawal of attention from relevant aspects of the task essential for success (Carver & Scheier, 1981; Miller, 1985). When one is ego involved, effort is less intense when success is attainable without much energy or when the task is so difficult that failure seems certain in spite of maximum effort: Why try hard when effort demonstrates a lack of ability? Unlike the Task+ boy, the Ego+ boy exerted less effort on the very difficult course (see Figure 1).

The Ego- group exerted the most effort on the very easy, easy, and difficult courses, significantly more than on the other two levels. When ego-involved individuals with low perceived ability want to hide their incompetence, "effort is high on easy tasks where failure, which would indicate low ability, appears avoidable by high effort" (Nicholls, 1984, p. 338). Unfortunately, it would appear that the aversive prospect of demonstrating one's incompetence may induce failure. The Ego- participants experienced less success than the Task- participants on the easy course (see Table 2), although exerted effort was quite similar (see Figure 1). Performance anxiety (Arkin, Detchon, & Maruyama, 1982; Sarason, 1975) or partial withdrawal of attention from the task may explain this failure. As Nicholls (1984) stated, the performance of ego-involved participants "can be impaired by self-derogatory ability evaluations even when effort is high" (p. 337). However, the motivational dynamics behind this finding will have to remain the focus of future research.

As predicted by achievement goal theory, Ego- boys exerted significantly less effort and performed worse than all the other groups on the moderate course. These participants may have expected to fail at the difficulty level that was the more "diagnostic" of their ability level; therefore, they anticipated demonstrating a lack of ability. For boys who categorized as Ego-, failure is less decisively demonstrated when effort is low (Jagacinski & Nicholls, 1984; Miller, 1985). This gives the Ego- boys a good reason for not trying, a strategy meant to protect self-esteem (Covington, 1992; Covington & Omelich, 1979; Frankel & Snyder, 1978). Under these conditions, the 0% rate of success is not surprising (see Table 2).

As Nicholls (1989) stated, "Impaired performance is likely when individuals with low perceived ability face tasks of intermediate normative difficulty" (p. 121). On the other hand, we note (see Figure 1) that the exerted effort of Ego-boys was higher on the difficult course than the average course. More effort on a difficult task allowed these participants the opportunity to demonstrate high ability (success at a difficult task), while failure may be rationalized by the difficulty of the task. Nevertheless this investment of effort was not as important on this course as on the easiest courses. This finding can be interpreted within achievement goal theory (Nicholls, 1984, 1989).

Nicholls (1984, 1989) differentiated three groups of ego-involved individuals with low perceived ability. The first group has not given up trying to prove its ability in an activity. Thus, these individuals still exert effort especially in difficult tasks, where failure does not yet mean that the participant is not "able." In the second group, individuals are more convinced of a lack of ability and less committed to proving their competence. Indeed, they try to avoid revealing their incompetence. They are more likely than those from the first group to adopt a strategy of exerting low effort when their chances of success are perceived to be low (in normatively moderate and difficult tasks). They exert greater effort only when their chances of success are high (in normatively easy tasks). In the third group, individuals are convinced of their low ability, so they do not even try to avoid demonstrating their incompetence any more (learned helplessness). They exert effort only if it helps toward other aims (mostly extrinsic) such as avoiding punishment, promise of reward, or opportunity to abandon the situation quickly. Therefore, there is not one but three behavioral patterns foreseen for individuals with low perceived ability. If individuals in each of these categories are supposed to provide effort on the easiest tasks, only those who still want to attempt to demonstrate their competence exert great effort on the difficult tasks (but probably not on the very difficult task, where failure is almost certain). The boys who have given up trying to establish their competence (those of the last two groups in Nicholls' classification) quickly give up when they perceive themselves as certain to fail.

Although the present results provided support for achievement goal theory, some limitations should be acknowledged and kept in mind when interpreting the findings. First, we did not measure the state of the boys' involvement. We inferred they were task or ego involved. We went to some pains to ensure they were one or the other by determining their goal orientation and placing them into a motivational climate in accord with their goal orientation. The manipulation check confirmed this. But we did not measure the state of involvement as others have done (e.g., Swain & Harwood, 1996; Williams, 1998). However, how one measures the state of involvement is in dispute. Typically, this work has used an adapted scale of dispositional measures (such as the Task and Ego Orientations Sport Questionnaire. Questionnaire or POSQ) that participants complete before a practice or a game. As Duda (2001) stated, such modified assessments are not a measure of an athlete's goal state (of task or ego involvement). Rather, it is a state goal orientation. Facing these constraints to measure goal states, currently unresolved, we preferred to maximize the likelihood that the goal state is adopted by matching the individual's dispositional tendency with the context, in accordance with the matching hypothesis (Duda, 2001; Swain & Harwood, 1996). This procedure is conceptually consistent with the theory and has proved to be effective in former studies (e.g., Cury, Biddle, et al., 1997; Cury et al., 1997).

Second, performance was determined by whether the boy successfully completed the climb. Each participant had the opportunity to have multiple trials, and there was no time constraint on the attempt to climb the rock face. But time on task could not be used as an additional measure of performance carried out, insofar as certain boys succeeded in little time, and others failed to climb after attempting to do so for 15 min. Thus, although this is a real world task, performance as measured in this study is not typical of many physical activity tasks, even though it may be typical of many sport contests.

Third, the measurement of effort retained here was a "momentary" personal maximal level of energy resources provided by each participant to climb each course, not a measure of the "total" expended energy to climb each course. Thus, it is possible that a participant who tried hard at one point obtained a higher value than someone who tried hard the whole time and expended more energy but never reached the same maximum value. Nevertheless, similar to several authors (for a review see, Wright & Kirby, 2001), we think it is important to make the distinction between the amount of work that must be carried out in total and the amount of work that must be carried out at a particular time.

In conclusion, the results of this experiment add additional support for the tenets of achievement goal theory in relation to exerted effort and performance in physical tasks. They confirm the adaptive role of task involvement (e.g., Duda, 2001; Nicholls, 1989; Roberts, 2001). When task involved, individuals try hard and perform well, particularly on challenging tasks. When ego involved, the motivational process seems more complex. Exerted effort depends both on perceptions of ability and the normative difficulty of the tasks. Nevertheless, this study confirms that ego involvement can foster nonadaptive behaviors, such as impaired effort or low performance despite high effort. But additional researches are needed to verify the findings and interpretations and especially to determine the dynamics of the cognitive and affective

factors that undermine performance despite high effort in the ego-involvement conditions.

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Notes

1. In this study, only boys were sampled (a) in order not to complicate more the design, and (b) because mountain climbing is, on the whole, evaluated as a stereotypically masculine activity; consequently, it is possible that girls value achievement less in this activity than boys.

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