PERCEIVED DIFFICULTY, RESOURCES INVESTMENT AND MOTOR PERFORMANCE

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PE teachers could have some problems when introducing motor learning tasks to students. For example, some girls refuse to work because they have "no talent for sports". Some students become discouraged because "the task is too difficult". Conversely some others seems sometimes capable to outdo themselves, when faced with motivating challenges.

The aim of this chapter is to show how students' representations of the task, of its nature and its difficulty, could influence effort investment and level of performance.

PE teachers often try to adjust the difficulty of the motor learning tasks to the resources that students have at their disposal. Nevertheless, a rational or "scientific" management of the requirements of the tasks does not necessarily guarantee the success of learning: students still have to agree to work, and to invest effort in the search for the solution to the problems which have been presented to them.

Then the teacher could have a lot of surprises: some students lose heart although the task is largely in their control, and some others succeed at tasks which are clearly too difficult. The behaviour of a given student can be very variable from one lesson to another, even when confronted with identical tasks.

In fact, the objective requirements of the learning tasks seem less important than the representation that students have of these requirements, and performance is less related to objective difficulty than to subjective difficulty, which constitutes a genuine interface between subject and the task to be solved.

The aim of this chapter is to analyse how the perception of the task can influence the investment of the subject, and affect performance. We will successively examine two aspects of the perception of difficulty: the first one refers to a quantitative conception which corresponds to the question: how difficult is the task? The second one raises the problem of the representation of the nature of task requirements.

1. A quantitative approach: how difficult is the task?

Perceived difficulty can be defined as the subjective assessment of the requirements of a task. "Perceived difficulty" is used here as a generic term, irrespective of the kind of the task to be performed. Note that a distinction is frequently made, according to the nature of the task, between perceived exertion, in the case of tasks mainly determined by physical effort, and perceived difficulty, strictly speaking, or perceived informational difficulty when the task is characterised by informational constraints. These two dimensions are obviously simultaneously present in most sports

tasks. Delignières, Famose, Thépaut-Mathieu and Fleurance (1993) have shown that in a complex task subjects were capable to assess them separately.

Another distinction must be made between an a priori assessment, i.e. before any attempts of the task, and an assessment during or just after performance. In the first case we will speak of estimated difficulty, and in the second, properly stated, of perceived difficulty.

1.1. What is the meaning of: "this task is difficult!"

Our preliminary definitions do not answer to the fundamental question of the nature of estimated or perceived difficulty. Some investigations have tried to analyse the determinants of difficulty assessment. These studies have shown the relative independence between perceived difficulty and outcomes achieved (Delignières & Famose, 1992). In other words, a subject could assess a task as easy even without obtaining satisfactory results, or conversely assess the task as difficult despite a good performance.

Recent work by Delignières, Brisswalter and Legros (1994) suggests that perceived difficulty reflects mainly the amount of resources, or effort, that subjects have invested in the task, to reach a given level of performance. This experiment has shown that when subjects had to perform a reaction time task under stressful conditions, those who presented better resistance to stress (those who achieveded the best performance), gave higher perceived difficulty ratings than those who reached poor performance. Inversely, some works have shown that with learning, subjects obtained progressively better performances in a given task, and found the task easier and easier (Bratfisch, Dornic & Borg, 1970). These results suggest that perceived difficulty is not directly related to objective task difficulty, nor to subjective performance, but reflects the amount of resources which have been invested in the task. So, when a student says "this task is difficult", this mainly means that he or she has worked very hard to accomplish it, or that he or she is going to work very hard.

It could be interesting here to refer to a useful distinction between task difficulty and goal difficulty. Task difficulty is related to the objective characteristics of the situation, a set of constraints which limits the possibilities of actions. Goal difficulty defines, for a given level of task difficulty, an outcome standard. Some experiments have tried to independently vary these two dimensions (e.g. Campbell & Ilgen, 1976). The results indicated that both goal difficulty and task difficulty affected performance, but in opposite directions: for a given task difficulty, difficult goals led to better performance than easy goals. Conversely, for a given goal difficulty, performance was poorer in difficult tasks rather than in easy tasks.

Adopting this conceptual framework, perceived difficulty appears more as an assessment of goal difficulty rather than as an assessment of task difficulty. This suggests that perceived difficulty is less determined by the direct experience of task constraints, than by an a priori decision concerning a performance standard to reach. From this point of view, the distinction proposed in the introduction between perceived difficulty and estimated difficulty seems purely formal: an experiment by Delignières

(1993) has shown that perceived difficulty presents a higher correlation with estimated difficulty rather than with effective performance.

These hypotheses lead to new considerations on the relationships between perceived difficulty, motivation, effort, and performance, and allow a link to be established between the themes of perceived difficulty and goal-setting.

1.2. Perceived difficulty and motor performance.

Much research in the area of goal-setting, in particular in industrial or organisational settings, has shown the positive influence of goal difficulty on performance: the more difficult the goals, the higher the performances. According to the authors, the assignment of difficult goals leads to greater investment of effort, and better persistence, as effort is provided until the goal or the sub-goal is reached (e.g. Latham & Locke, 1975).

The cognitive theories of motivation offer an interesting frame to analyse the relationships between goals, effort and persistence: the subjects persist in their efforts as long as they perceive a discrepancy between the goal and the actual outcome. Goal-setting allows this discrepancy to be created and structured. The motivational theory of Kukla (1972) gives an understanding of the role of the estimation of difficulty in the determination of the amount of effort which will be invested in the task. According to this author, for a given task subjects choose the minimal level of effort which allows the required outcome to be reached. If subjects estimated the task as easy, then they would think that little effort was necessary to reach the goal. The increase of the level of estimated difficulty leads to a monotonous increase of intended effort. The theory suggests that, at least within certain limits which have to be determined, invested effort and hence performance are proportional to subjective difficulty.

This positive effect of goal difficulty on performance seems to be very important in physical education. Often teachers do not dare to assign ambitious goals, in order to avoid discouraging students. We think, conversely, that the assignment of significant challenges is necessary to induce a true investment of effort by students, and a real learning process during PE courses.

Observe yourself: are you sufficiently demanding of your students? Often teachers tend to reduce goal difficulty to allow the whole class to be successful. For example, the required level of performance for the 1983' French baccalauréat was, for boys, to run a distance of 3200 meters in 20 minutes. This goal was clearly on the side of the capacities of most of the students.

Nevertheless, the assignment of significant challenges raises the problem of the expertise of the teacher in the sport at hand. Each PE teacher is more or less a specialist in one or two sports. You can be a specialist in gymnastics, or in football. Are you really able to give your students significant challenges in other activities you yourself cannot master? Often the ease of the goals assigned to students is related to the lack of expertise of the teacher in the sport being taught.

Locke and Latham (1985) suggested that this monotonous relationship between goal difficulty and performance was valid only if the assigned goal was realistic: if a subject assessed the task as too difficult, he/she stopped investing effort. As well, Kukla (1972) has postulated that the amount of effort is limited by a subjective maximum. When the level of estimated difficulty is such that the necessary amount of effort seems superior to the conceivable maximum, in other words, when the subject has the feeling that whatever the investment, all attempts are doomed to failure, then he/she turns away from the task and investment returns to zero.

This hypothesis of the realism of goals was frequently evoked in the domain of sport psychology (e.g. Boterill, 1979). It implies that it is necessary to individualise goal difficulty according to the resources that each subject has at his disposal.

This proposition raises obvious problems at a practical level. If one trainer can effectively manage the individualized and different goals of each of his/her athlete(s), are you really able to do the same with a class of 30 students? Is it possible to offer each student individual goals, adapted to his/her capabilities?

Note that experimental work has shown that unrealistic goals, clearly exceeding the capabilities of subjects, did not necessarily lead to a decrease of motivation or of effort investment. In the domain of physical activity, such results were evidenced in a series of experiments using tasks such as sit-and-reach, handgrip dynamometer, or basket-ball shooting (e.g. Weinberg, Fowler, Jackson, Bagnall & Bruya, 1991; Figure 1). These studies suggested that even if subjects considered "unrealistic" goals as effectively extremely difficult to reach, this had no influence on the effort they intended to invest.

Several hypotheses have been proposed to explain these results. A possible specificity of physical activities has been evoked: sport activities could be more intrinsically motivating, and this could explain the difficulties of replicating using sport tasks results obtained in industrial settings. Moreover, nothing proves that assigned goals were really taken into account by subjects. The subject is moved by his own goals, which can be only influenced by the goals which have been assigned. So it was possible that subjects in the "unrealistic goal" condition chose more acceptable goals, and in so doing protected their motivation and their level of performance. The same reasoning was conceivable for subjects which had been assigned too easy a goal.

We think that in the domain of physical activities the teacher does not have to be afraid of proposing high goals to students. If a student estimates the task as being achievable, he/she will try to reach the assigned goal and will invest effort. If the goal is assessed as unrealistic, one surely would define an alternative goal, more adapted to one's capabilities, but difficult enough to allow progress. Teachers' current standard behavior without a doubt limits the progress of the students, by assigning them goals which are too easy.

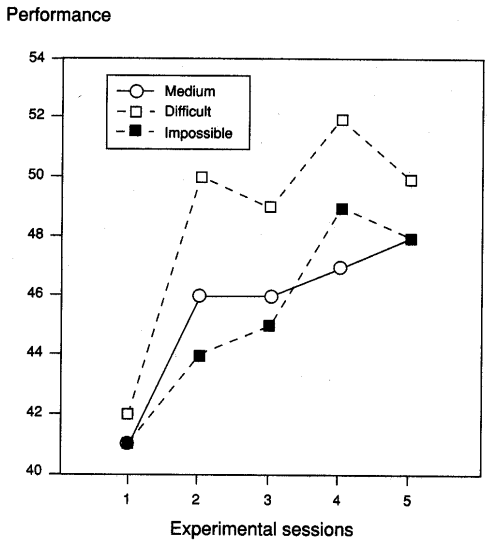

Figure 1: Relationship between the level of difficulty of the goal and performance in a sit-up task over 5 practice sessions (figure composed from data reported by Weinberg et al., 1991). Statistical analyses did not reveal any significant differences between groups.

Nevertheless, don't try to systematically assign impossible goals to students. Those experiments on unrealistic goals used relatively simple tasks, allowing an easy goal re-setting. If you assign as goal to your students to make a 2 1/2 salto from 3 meters high trampoline in diving, one could suppose that this goal will be in most cases rejected. To encourage students to participate, it is surely necessary that goals, even difficult or extremely difficult, could be conceived as accessible to a "normal" subject, even with a hard work.

1.3. The perception of difficulty or exertion.

A number of authors have tried to describe the relationship between objective and perceived difficulty (or exertion). These studies have shown that the relationship was positively accelerated: for example, this relationship in simple perceptual-motor tasks has been accurately described according to an exponential function, with an average exponent of 0.4 (Delignières & Famose, 1992; Figure 2), and Borg (1962) showed that perceived exertion appears as a power function of objective effort, with an average exponent of 1.6 (Borg, 1962).

This positive acceleration suggests that the sensitivity to difficulty increased as tasks became more difficult: a given increase in objective difficulty corresponded to a considerable increase in perceived difficulty when the task was difficult, but to a lower increase when the task was easy. So be careful when you manage the difficulty of tasks that have already been assessed as difficult by your students.

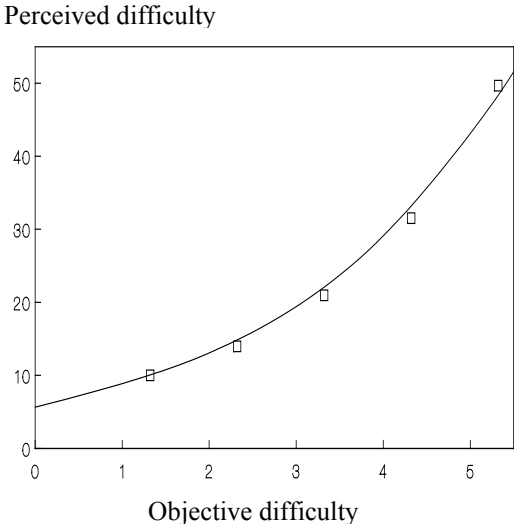

Figure 2: Relationship between the index of objective difficulty and perceived difficulty in a reciprocal tapping task (from Delignières and famose, 1992).

Imagine, for example, that you give your students a climbing task. You propose at a given time to increase the difficulty by one degree, by modifying the handles' location. A student who assessed the first task as moderately difficult will accept without problem this new challenge. Conversely, another student, assessing the first task as difficult could be discouraged by this increase in objective difficulty. Note that these processes are not systematically related to students' objective capabilities.

The exponent of the function "objective difficulty-subjective difficulty" could be considered as a measure of global sensitivity to difficulty. The values of exponents that we have indicated previously are only mean values, and some studies suggested large inter-individual differences at this level: for some subjects a given increase in objective difficulty corresponded, on average, to low alterations of perceived difficulty, when for other subjects the modifications in perceived difficulty were much more important (Delignières & Famose, 1994). It is also clear that different subjects facing a given task perceive different levels of difficulty. The teacher must take these inter-individual differences into account and understand their meaning.

Some experiments have shown high similarities in the assessment of difficulty, across tasks and within subjects. More specifically, the individual exponent of the function "objective difficulty-perceived difficulty", seems to be invariant from one task to another, whatever the nature of the required resources (Delignières & Famose, 1994). A recent experiment (Delignières & Brisswalter, 1996) suggested that this invariance is not only valid for perceptual-motor tasks but, more broadly, also for reasoning tasks and tasks involving physical exertion. The exponent of the psychophysical function therefore seems to be a characteristics of the subject, independent of the nature of the assessed tasks. It constitutes a measure of the acceleration of the function, and could represent an index of the individual sensitivity to difficulty.

Practically, this implies that when you increase the objective difficulty of a task, some students will perceive this increase as moderate, and some others as major. This

generally leads to an over-estimation of difficulty in high sensitive subjects, and conversely to an under-estimation in less sensitive subjects.

Some authors tried to understand the antecedents of these inter-individual differences. Dornic and Birbaumer (1974) studied perceived difficulty in a task under temporal pressure, with normal and neurotic subjects. This experiment showed that perceived difficulty was a linear function of available time with normal subjects, but an accelerated transformation of available time in neurotics. Delignières (1993) has compared the exponents of a group of expert rock-climbers and a group of sedentary subjects in the assessment of the difficulty of Fitts' tapping tasks: the mean exponent for climbers was significantly lower than the exponent for the other group (.30 vs .38, Figure 3). These results suggested that certain personality variables, or some kinds of expertise may be important antecedents of the individual sensitivity to difficulty.

A question frequently tackled has been the influence of sex on perceived exertion. A hypothesis commonly proposed was that as effort corresponded to "male values", females would perceive higher levels of exertion than males, at an equivalent level of objective effort. For example Dill, Rejeski and Ribisl (1981, cited by Rejeski, 1981) have shown that in a running task of equivalent relative intensity (80% VO2max), perceived exertion was significantly lower for males.

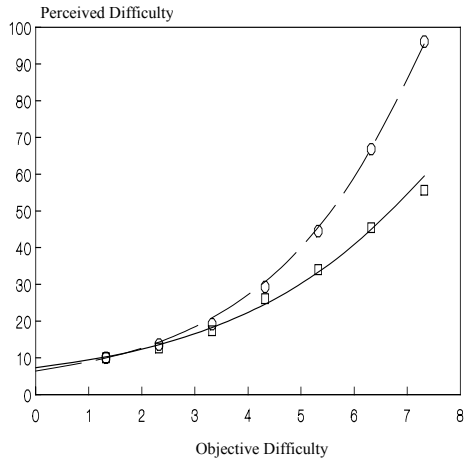

Figure 3: Relation between objective difficulty and perceived difficulty in reciprocal tapping tasks. Squares: expert climbers, circles: control group (from Delignières, 1993).

In many cases the results were divergent. For example Wrisberg, Franks, Birdwell and High (1988), have studied the assessment of exertion in a running task on a treadmill, with a group of expert runners, and have obtained higher ratings for males than for females. From a slightly different point of view, Delignières and Famose (1991) carried out an experiment on the estimation of the requirements of verbally described walking tasks, with two groups of children aged 12 and 16 respectively, and also with a group of PE teachers. There were no differences between boys and girls in the 12 years old group. In the 16 years old group, girls gave significantly higher

estimations than boys. Conversely, within the teachers group, females gave lower estimations than males.

Some works have emphasised the influence of sports expertise on the "objectivity" of perceived exertion: for example Sylva, Byrd and Mangun (1990) showed no differences between male and female top-level athletes, for perceived exertion in tasks of equivalent relative intensity. While in sedentary subjects systematic differences seemed to appear between sex in the perception of exertion, these differences tended to disappear in sports experts.

Beyond biological sex, some experiments on the influence of sex roles have yielded more consistent results. Hochstetler, Rejeski and Best (1985) studied perceived exertion in a group of women. The subjects were classified according to a specific inventory as feminine, androgynous or masculine. Results showed that feminine subjects gave higher ratings of perceived exertion than androgynous or masculine subjects. These results have been replicated with male subjects. One could note that in the previously cited experiment by Delignières and Famose (1991), differences between sexes appeared only during adolescence, an important period for the structuring of sex roles.

Moreover, sport expertise and sex roles seem to be intimately related. Some authors have clearly shown that sportswomen presented more masculine traits than sedentary women (e.g. Salisbury & Passer, 1982). This gives a possible explanation for the results obtained in previously cited experiments, on the perception of exertion with sports experts (Delignières & Famose, 1991; Wrisberg et al. 1988).

These results have important implications for physical education. First, the teacher must keep in mind the risk of systematic overestimation of difficulty with girls, especially during adolescence. Lastly, PE teachers, males or females, are generally sports experts, and possess marked masculine trends. This could lead to important discrepancies between their estimations of difficulty, and those of their students, especially girls. Davisse and Louveau (1991) particularly raised the problem of female PE teachers, described as "atypical of their sex" because of their masculine dominance: are they the most capable to teach PE to girls?

The propositions developed in this part are obviously in complete contrast to those previously evoked. They offer a complementary aspect of this complex problem of the adaptation of task difficulty.

1.4. Practical tools for the assessment of perceived difficulty

A teacher may need to assess during the courses the level of difficulty perceived by the students. Some authors have constructed simple assessment tools, appropriated for field use. Borg (1970) has proposed the well-known RPE scale, for the assessment of perceived exertion (figure 4, left). This scale is composed of 15 points, numbered from 6 to 21, and is anchored all two points with verbal labels, from "very, very light" to "very, very heavy". This scale was constructed to produce a linear relationship

between objective effort, assessed by heart rate, and perceived exertion in submaximal cycloergometer exercise.

More recently, Delignières, Famose and Genty (1994) have constructed and validated a category scale for the perception of informational difficulty, called DP-15 (figure 4, right). This scale produced a linear relationship between objective and perceived difficulty in simple perceptual-motor tasks.

Clearly these scales cannot give any information on the form of the "objective difficulty-subjective difficulty" relationship, as they were constructed to produce a linear relationship. However they allow inter-individual comparisons on levels of perceived exertion or perceived difficulty: it is possible to affirm that a subject which rates an effort at 9 on Borg's RPE scale has perceived a lower level of exertion than another subject who gives a rating of 13.

6		1	
7	Very, very light	2	Extremely easy
8		3	
9	Very light	4	Very easy
10		5	
11	Fairly light	6	Easy
12		7	
13	Somewhat hard	8	Somewhat difficult
14		9	
15	Hard	10	Difficult
16		11	
17	Very hard	12	Very difficult
18		13	
19	Very, very hard	14	Extremely difficult
20		15	

Figure 4: Left: The RPE scale for perceived exertion (from Borg, 1970). Right: The DP-15 rating scale for perceived difficulty (from Delignières, 1993).

From a practical point of view, these category scales appear very interesting. For example some experiments have demonstrated the practical usefulness of Borg's RPE scale, in order to prescribe a given level of exertion (e.g. Dunbar, Goris, Michielli & Kalinski, 1994). These experiments have shown that subjects are able to produce, in running or pedalling tasks, exertion levels prescribed according to RPE ratings. This method of effort regulation, while essentially subjective, gave more accurate results than more classical methods such as heart-rate monitoring (Dunbar et al., 1994). Mainly developed in the domain of cardiac rehabilitation settings, this approach has not been tested in the domain of PE teaching. Nevertheless, it seems an interesting and practical way to regulate the intensity of the exertion requested from students.

Try to use these scales. Rate the difficulty of the tasks you want to assign to your student, and then ask them to do the same. This simple exercise should allow you to understand your own assessment behaviour, to know if important discrepancies exist with the ratings given by your student, and finally if there are between students differences.

2. A qualitative perspective: What is the nature of the task?

The first part has mainly focused on an intensive approach of perceived difficulty. Some other points of view, more qualitative, could be adopted, related to the perceived nature of the task, and the kind of goals really followed by subjects.

2.1. The perceived nature of the required resources: aptitude vs effort.

Some experiments have shown that the conceptions about task difficulty induced by the researcher or spontaneously used by the subjects, have an important influence on motor performance and motor learning. Namely, when subjects believed that performance was mainly determined by skill and learning, they invested more effort and reached significantly higher outcome levels than when they believed the performance to be mainly related to aptitudes or innate capabilities.

Jourden, Bandura and Banfield (1991) have specifically studied the influence of these conceptions. Subjects had to perform a rotary pursuit task. The first group was told that this task was designed to assess a stable and untrainable ability. Conversely the instructions given to the second group emphasised the role of learning and effort on performance. In the second group results showed a greater interest for the task, a better level of performance, more positive reactions to outcomes and a reinforcing of the feeling of competence (figure 5).

It is important for the subject to have the conviction that the factors susceptible to affect his performance are under his or her control. If the subject estimates a failure to be related to a skill deficit or a lack of effort, controllable and improvable factors, he or she would persist in attempts to reach the goal. Conversely, if one has the impression that failure is related to stable factors (e.g. an aptitude or a morphological characteristics), or to external and out-of-control factors (chance, referee's decisions, opponent's strength), one would tend to withdraw from the task (Rudisill, 1990).

Many students are convinced that success in sport is mainly determined by innate capabilities. The teacher should fight against this "talent ideology", and to promote effort and learning. Try to analyse the manner you present tasks to your students, or observe your colleagues: is the role of effort really promoted? Do you really insist on the possibility to make progress in the task, with work and implication?

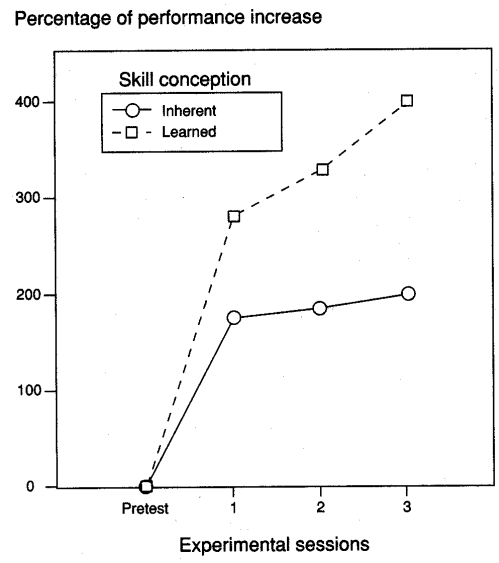

Figure 5: Increase percentage of performance in a rotary pursuit task over 3 practice sessions, according to the conception of task's requirements induced by experimenters (inherent ability or learned skill). Adapted from Jourden, Bandura & Banfield (1991).

2.2. Mastery goals vs competitive goals.

The theory of motivational orientation offers an interesting frame in which to integrate the previous propositions. Recent approaches explain achievement motivation through an individual need to demonstrate one's competence. A subject who acts in an achievement situation tries to demonstrate competence, or to avoid showing lack of competence.

Two conceptions of competence have to be distinguished. According to the first one, competence is referred to the performance of others: one estimates oneself as competent if one has realised a better performance than others. Competence is exo-referenced, determined by a process of social comparison. According to the second conception, competence is determined by individual standards of mastery and performance improvements. The subject seeks to reach a performance standard, independent of the performances of others. These conceptions determine two fundamental motivational orientations: the competitive and mastery orientations (Roberts, 1984).

These motivational goals are related to differentiated conceptions relative to skill, or effort, and their contribution to performance. Some authors have shown that in the sport domain, mastery-oriented subjects perceive success as being dependent on effort and persistence (Duda, Fox, Biddle & Armstrong, 1992). In this case, skill and effort are considered as two necessary means to improve performance. Conversely, competition-oriented subjects think that success mainly reflects a superior ability, and also frequently refers to chance. Moreover, for these subjects, effort constitute an

equivocal investment, as a success obtained with an important effort may be minimized, and a failure suffered despite a significant effort is difficult to justify.

According to Roberts (1984), subjects who opt for competitive goals do not persist in case of failure. Failure affects the feeling of competence, and the expectation level, persistence and performance will decrease. Conversely mastery-oriented subjects tend to consider errors and failures as natural components of the acquisition of skills: they learn from failures, which do not affect their persistence in effort.

Rudisill (1990) has effectively shown in three motor tasks (dart throwing, long jump and a flexibility task), that mastery orientation leads to higher expectation levels, better persistence, and higher levels of performance (Figure 6).

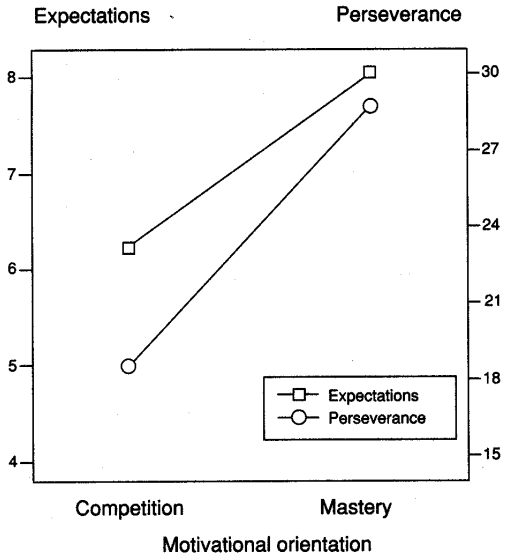

Figure 6: Influence of motivational orientation on performance expectations and persistence in a flexibility task (figure composed from data reported by Rudisill, 1990).

In conclusion, mastery orientation seems more favourable in order to induce effort investment and learning. Even if motivational goals are in part determined by individual variables, the teacher could play a decisive role at this level. Some authors have demonstrated that it was possible to incite students to opt for mastery goals, by the motivational climate instituted in the classroom (Ames & Ames, 1984). The motivational climate is related to the nature of the goals assigned to students, the evaluation and reward process, and the type of relationships between students induced in the classroom. In the organisation of their courses teachers should try to avoid any inter-individual comparison and to try to give to each student individualised goals and performance standards.

It is not so easy to modify one's own teaching style. Try first to clarify your own motivational orientation. Are you competition- or mastery-oriented? Do you believe success to be related to victory against others, or to the attainment of personal goals?

This could allow you a better awareness of your teaching strategies, and to gradually introduce more mastery components in your courses.

Conclusion

Often the term "subjective task" refers to the subject's representation of the problem he/she has to solve. This conception has been widely discussed, essentially through the necessity of taking into account these initial representations in the teaching process. We have preferred to focus in this text on two less developed aspects of "subjective task", the quantitative assessment of difficulty, and the perception of the nature of the requirements of the task. We think that this point of view allows some original statements to be made concerning the adaptation of task difficulty or the management of motivational climate.

Summary

Motor performance is not mechanically determined by the confrontation of a resources system to objective task constraints. The subjective assessment of the level and the nature of the difficulty of the task constitutes an important mediator of subject's emotions, motivation and effort. Some characteristics of perceived difficulty must be kept in mind by physical educators:

- Perceived difficulty seems closely related to effort investment. Teachers have to offer significant challenges to their student, in order to promote effort and learning.

- Each individual seems to be characterised by a sensitivity to difficulty which determines the manner with which he/she perceives the level and the variations of the level of requirement of tasks.

- There are great inter-individual differences in this sensitivity to difficulty. Some personality dimensions, such as sex roles, appear to have a great importance at this level. As a teacher you must keep in mind the gap which could exist between your own sensitivity and the sensitivity of your students.

- The perception of difficulty refers, from a more qualitative point of view, to the subject's conceptions relative to the nature of the goal and of the required resources. The teacher could incite students to adopt optimal conceptions, on the one hand by a clear statement of the goals, and on the other hand by the institution of a mastery climate in the classroom.

Review Questions

1. What is the difference between task difficulty and goal difficulty?
2. Describe the relationships between assigned and self-assigned goals, and effort investment.
3. Explain the meaning of "sensitivity to difficulty".
4. Do sex and sex roles influence the perception of difficulty? If so, in what way?
5. Describe the relationships between motivational orientation and conceptions about competence.

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