Journal of Sports Sciences, 2003, **21**, 631–647

Taylor & Francis
healthsciences

Predicting motivational regulations in physical education: the interplay between dispositional goal orientations, motivational climate and perceived competence

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Accepted 24 April 2003

In this study, we examined the main and interactive effects of students' goal orientations, perceived competence and perceptions of the motivational climate on the motivational styles advanced by self-determination theory. The participants were 328 British secondary school students aged 13.6 ± 0.6 years (mean $\pm$ *s*). Moderated hierarchical regression analyses revealed task orientation, perceived competence and perceptions of a mastery climate to be positive predictors of self-determined styles of motivation. Perceived competence in physical education was negatively associated with amotivation. Significant interaction effects for mastery climate $\times$ task orientation and for ego orientation $\times$ perceived competence emerged. The results indicate that: (1) for students endorsing a high task orientation, the perception that the class climate was high in mastery cues was associated with increased intrinsic motivation; and (2) for students high in ego orientation, the belief that one was competent increased, while perceptions of incompetence attenuated intrinsic motivation. Additionally, a three-way interaction between ego orientation, performance climate and perceived competence emerged. In light of achievement goal and self-determination frameworks, we propose that studying the potential interplay between both individual and situational goal perspectives and the moderating effect of perceived competence may further enhance our understanding of motivation in physical education.

Keywords: achievement goals, competence, physical education, self-determination theory.

Introduction

Research directed at enhancing our understanding of the motivational processes that underpin adaptive engagement in the context of school physical education (PE) has increased significantly during the past decade. The emergence of this work has largely been commensurate with position statements and research reports calling for increased physical activity (e.g. ACSM, 2000). To this end, PE has been advanced as 'the setting with the most promise for having a public health impact . . . because virtually all children can be reached in schools' (Sallis *et al.*, 1992, p. S251).

A substantial number of studies focused on achievement motivation in PE settings have been grounded in achievement goal frameworks (see Biddle, 2001). Assuming that the demonstration of ability is the primary intent of individuals, research from this perspective examines how individuals define success (or failure), judge their ability and assign meaning to achievement endeavours (Nicholls, 1989). Nicholls (1984, 1989), in particular, proposed that two conceptions of ability become manifested in achievement settings through two diverse states of goal involvement, referred to as 'task' and 'ego'. *Task* involvement entails holding a self-referenced perception of ability in which the individual believes subjective success to be evidenced through developing new skills, exerting maximum effort and improving personal performance (Nicholls, 1989). In a state of *ego* involvement, the individual's focal concern is towards demonstrating favourable normative comparisons relative to others. When ego-involved, subjective success is normatively referenced, and ability is evaluated based on whether one outperforms relevant others or performs equally well but exerts less effort (Nicholls, 1989). Variations in these two goal states are held to direct individuals'

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interpretation of demonstrated ability, perceptions of successful goal accomplishment and, subsequently, serve as critical antecedents to variations in motivational behaviour, cognitive processes and emotional responses (cf. Duda, 2001).

One specific line of research from an achievement goal perspective (Nicholls, 1984, 1989) has examined the relationship between dispositional goal orientations and/or perceptions of the motivational climate and intrinsic motivation. Most of this previous work, however, assessed intrinsic motivation as a unidimensional construct. This approach is inconsistent with the more contemporary postulates of self-determination theory (Deci and Ryan, 1985, 1991; Ryan and Deci, 2000). Indeed, self-determination theory (Deci and Ryan, 1985, 1991) identifies three motivation styles, namely 'intrinsic motivation', 'extrinsic motivation' and 'amotivation'.

Defined as doing an activity for its inherent satisfaction as opposed to separable consequences, *intrinsic* motivation represents the most self-determined regulation (Ryan and Deci, 2000). Vallerand and colleagues (e.g. Vallerand *et al.*, 1992) have built upon the unidimensional approach to intrinsic motivation by proposing a tripartite taxonomy of intrinsic motivation. This trichotomous approach suggests intrinsic motivation can be differentiated into more specific motives that are equal in their extent of self-determination. As such, it is held that individuals can vary in their intrinsic motivation to know, intrinsic motivation towards accomplishments and intrinsic motivation to experience stimulation (see Vallerand, 2001, for an explanation of each construct).

When an individual's goal of action and/or incentives extends beyond those inherent within an activity, then their motivation is deemed to be extrinsic in nature (Deci and Ryan, 1985). Situated on a continuum, ranging from lower to higher levels of self-determination, *extrinsic* motivation embraces external, introjected, identified and integrated regulations. *External* regulation represents non-autonomous behaviours that are dictated by externally controlled factors (e.g. reward, threats). *Introjected* regulation refers to actions that are performed by an individual when they feel that they should partake in an activity. With introjected regulation, engagement in the activity is still controlled externally (i.e. compliance), yet the source of control is internalized (e.g. self-guilt). That is, in contrast to external regulation, actions arise from the feeling that 'I should' partake in an activity as opposed to the feeling that 'I must' participate. In the context of PE, however, this distinction is more likely to refer to who is applying the pressure. *Identified* regulation represents the stage at which the individual partakes in an activity because they accept the behaviour as important. Finally, self-determination theory encompasses *integrated* regulation as a type of extrinsic motivation. Integrated regulation is the most self-determined form of extrinsic motivation and occurs when identified regulations have been incorporated within the self. Research has shown, however, that children and adolescents may be too young to experience or have achieved a sense of integration within their self (Vallerand, 1997, 2001). As such, this construct is neither assessed nor elaborated on further in the present study.

The least self-determined motivational regulation is referred to as *amotivation*. Amotivation stems from feelings of incompetence, lack of activity value and the belief that one's actions have little, if any, bearing on outcome(s) (Ryan and Deci, 2000). When in a state of amotivation, it is presumed that one lacks intent to act and has little, if any, desire to invest in the activity.

Self-determination theory proposes that the quality of performance, learning, personal experience and well-being are contingent upon the motivational regulation that an individual adopts. That is, motivational styles high in self-determination (e.g. intrinsic motivation and identified regulation), as opposed to those low in self-determination (e.g. external regulation and amotivation), are assumed to yield more motivationally adaptive responses. Research in the extant physical activity literature has supported this theoretical tenet (see Vallerand, 2001, for a review).

Recent research in the PE context has drawn from contemporary achievement goal perspectives and moved towards examining the relationship between dispositional and/or situational goal perspectives and multidimensional motivational regulations (e.g. Brunel, 1999; Standage and Treasure, 2002). Nicholls (1989) argues that motivational orientations do not only emphasize different types of wants or goals, but they underpin wider views, including the purposes of the achievement activity itself. Thus, concerns regarding 'how' the individual construes his or her ability may account for different reasons for 'why' they are participating in an achievement activity.

Because of its focus on improvement, learning and self-development at achievement tasks, Nicholls (1989) and Deci and Ryan (2000) both consider task involvement to be intimately linked to intrinsic motivation. This is because individuals with high task orientation place great emphasis on task improvement and mastery and, therefore, they are more likely to be motivated by the intrinsic aspects of a task (as noted earlier, two facets of intrinsic motivation measure motivation to learn new skills and motivation to accomplish mastery on already learned skills). Moreover, when the criterion underlying success is self-referenced, it is more within the person's control and is more likely to make perceptions of adequate ability more resilient. Support-

ing these theoretical standpoints, previous work has shown an individual's proneness towards task involvement (known as task orientation) and/or perceptions of a climate rich in task-involving cues (a mastery climate; Ames, 1992a) to correspond to higher intrinsic motivation towards PE (Brunel, 1999; Standage and Treasure, 2002). Nicholls (1989) also posited a negative relationship between ego involvement and intrinsic motivation, while Deci and Ryan (1985) suggested a decrease in intrinsic motivation should lead to an increase in extrinsic motivation. The relationship between ego involvement and the various types of extrinsic motivation is, however, less clear (Deci and Ryan, 2000). This is because extrinsic motivation is underpinned by different motivation styles that differ in their degree of self-determination.

Research has shown task orientation and perceptions of a mastery climate to be associated with identified regulation, which is held to be a relatively self-determined style of extrinsic motivation (Brunel, 1999; Standage and Treasure, 2002). The relationship between task orientation and identified regulation may be attributable to the fact that individuals are likely to only invest and seek mastery in activities that they deem to be important (Deci and Ryan, 1985).

Deci and Ryan (2000) liken ego involvement to the motivational style of introjected regulation, arguing that when someone is ego-involved towards an activity, his or her focus is on self-perceptions of ego and/or self-worth enhancements. Ryan (1982), among others, has demonstrated that when individuals are ego-involved in an outcome, they tend to experience reductions in intrinsic motivation towards an activity. Previous work has shown ego orientation to correspond positively to introjected regulation in sports settings (Ntoumanis, 2001a).

A strong emphasis on ego involvement has been shown to be associated with beliefs about PE that suggest a concern with the extrinsic facets of involvement (Duda, 1996). Regarding views about the purposes of PE, high ego orientation has been shown to be coupled with a focus on the outcome, receiving recognition from significant others and obtaining rewards (Walling and Duda, 1995; see Duda, 1996). These controlling foci represent key constituents of the construct 'external regulation' (cf. Vallerand, 2001). Previous work with college-age participants in PE has shown ego orientation and perceptions of a performance climate to be positively associated with external regulation (Brunel, 1999).

Past studies have also shown ego orientation and perceptions of a performance climate to be weakly associated with reported amotivation (Brunel, 1999; Standage and Treasure, 2002). When ego-oriented or when exposed to a situation that emphasizes outperforming others and the salience of relative ability, it is difficult for students who are concerned about their ability to maintain an active, unselfconscious involvement (Nicholls, 1989). Indeed, when social comparisons are emphasized, perceptions of normative competence are 'put on the line'. Such a focus may lead the unsuccessful student to engage passively in PE (i.e. become amotivated) because of feelings of incompetence, a lack of control over desired outcome(s) and/or a lack of activity valuation (Deci and Ryan, 2000).

To date, PE-based studies have examined goal orientations and perceptions of the motivational climate *independently* with respect to their relationship with the motivational styles proposed by Deci and Ryan (1985, 1991). Achievement goal theorists contend that it is the interplay between one's goal orientations and perceptions of the motivational climate that influences the probability that an individual will be task- or ego-involved. That is, while Nicholls (1989) contends that a dispositional tendency (goal orientation) towards task and/or ego increases the likelihood of adopting a parallel state of involvement, 'situational factors are seen as potentially altering these probabilities' (Dweck and Leggett, 1988, p. 269). Dweck and Leggett (1988) contend that when mastery or performance environmental cues are not pronounced, an individual's disposition should hold sway and predict motivation. On the other hand, if situational cues are strong, they may override dispositional goal orientations and influence motivational processes.

Recently, in support of the adoption of an interactionist paradigm (e.g. Diener *et al.*, 1984; Mischel, 1977; Shoda, 1999), researchers have argued the importance of examining person × situation interaction effects as we endeavour to comprehend and predict motivation-related variables in physical activity settings (e.g. Swain and Harwood, 1996; Treasure and Roberts, 1998; Duda and Hall, 2001; Treasure, 2001). A contemporary line of inquiry in the context of sport has used moderated hierarchical regression to examine whether the interaction between goal orientations and perceptions of the motivational climate can account for additional variance in the cognitive and affective variables of interest, beyond that explained by main effects (Swain and Harwood, 1996; Treasure and Roberts, 1998; Newton and Duda, 1999). In general, this work has supported the adoption of an interactionist approach to research on goal perspectives in sport. To our knowledge, however, no investigation has used this approach with PE.

Nicholls (1989) also identifies perceptions of high and low normative ability to be germane to the study of achievement patterns. Nicholls (1989) and others (e.g. Dweck, 1986) have argued that, while normative

competence should not have any relevance for the motivational strivings of the highly task-oriented student, perceptions of one's relative ability has important motivational implications for students who are predominantly ego-involved. Indeed, in view of the normative nature of ego involvement, individuals who have low perceptions of comparative ability are likely to display maladaptive behaviours (e.g. withdraw effort), rather than encounter the aversive emotions and self-perceptions associated with failure (Dweck, 1986). It is assumed that only ego-involved individuals with a high perception of ability will demonstrate high motivation (Dweck, 1986; Nicholls, 1989). A parallel pattern of predictions holds with respect to students' perceptions of the climate (cf. Nicholls, 1989). That is, while variations in perceptions of ability should have little influence on the motivation of students perceiving a climate strong in mastery features, students exposed to a pronounced ego-involving climate who doubt their ability are expected to manifest maladaptive motivational responses.

In addition to operating as a hypothesized moderating variable in the achievement goal framework, the construct of competence plays a central role in Deci and Ryan's (1985, 1991) self-determination theory. Competence is presumed to be a basic innate psychological need (the others being autonomy and relatedness) in the self-determination framework. This theory holds that these three mediating needs must be met by one's social environment to foster positive psychological development (cf. Deci and Ryan, 2000).

The aim of the present study was to examine the main and interactive effects of dispositional goal orientations, perceptions of the motivational climate and perceptions of competence on students' motivational regulations in PE. In contrast to previous work, which included all possible main and interaction terms in the regression analyses (e.g. Newton and Duda, 1999), the aim of the present study was to explore five theoretically grounded hypotheses. Such an approach was adopted because of concerns about Type I errors. The specific hypotheses explored were as follows (the interaction terms pertinent to each hypothesis are shown in brackets below the relevant hypothesis):

1. Aligned with the theoretical tenets of achievement goal theory (Nicholls, 1989) and consistent with previous work, we predicted significant main effects for task orientation and perceptions of a mastery climate in predicting intrinsic motivation. Moreover, based on recent work, we believed that task orientation and perceptions of a mastery climate would also predict identified regulation.

2. Consistent with self-determination theory (Deci and Ryan, 1985, 1991), we expected perceived competence to positively predict self-determined motivational styles (three intrinsic motivation styles and identified regulation) and negatively predict styles of motivation considered to be low in self-determination (external regulation and amotivation).

3. We hypothesized that significant interaction effects between goal orientations and perceptions of the motivational climate would emerge aligned with Dweck and Leggett's (1988) contentions. That is, situational cues were expected to moderate students' dispositional goal orientations to predict their self-regulatory style.

   (task orientation × mastery climate; task orientation × performance climate; ego orientation × performance climate; ego orientation × mastery climate)

4. In view of the proposed moderating role of normative ability for those high in ego orientation (Nicholls, 1989), significant interactions were expected to emerge between ego orientation and perceived competence in predicting indices of student motivation. Indeed, we hypothesized that highly ego-oriented individuals with low perceptions of competence would report lower scores on facets of intrinsic motivation and higher scores on motivational styles low in self-determination (i.e. external regulation and amotivation). An inverse pattern was expected for those high in perceived competence. Ego-oriented students with high perceptions of competence were expected to report high intrinsic motivation. We also expected the moderating effect for perceived competence to emerge for individuals perceiving a high performance climate. Finally, a three-way interaction term consisting of ego orientation, performance climate and perceived competence was predicted. We expected that students that have low perceptions of competence, are high in ego orientation and perceive the class structure as highly performance-oriented should report the lowest self-determination.

   (ego orientation × competence; performance × competence; ego orientation × performance climate × competence)

5. Given the proposed orthogonality between task and ego goal orientations (Nicholls, 1984, 1989), Hardy (1997) pointed out that this orthogonal nature

implies that the constructs should interact to predict various motivational outcomes. The present work examined whether task and ego goal orientations interact to predict motivational styles. We hypothesized that task and ego orientation would interact to predict the different motivational styles.

(task orientation × ego orientation)

Methods

Participants and procedures

The participants were 328 children (160 males, 138 females, 30 did not specify) aged 12–14 years (mean $\pm s$: 13.6 ± 0.6 years). They attended two secondary schools, one in the Midlands and one in the north of England. Both schools were located in predominantly middle-class areas and data were collected from seven PE classes. Although ethnicity/race information was not obtained, observations made by the first investigator indicated that the samples were predominantly caucasian. The data were collected towards the end of the spring academic session so as to ensure that the students' perceptions of the motivational climate had been established. Before collection of the data, permission to conduct the study was obtained from the investigators' School Human Subjects Committee, and informed consent was obtained from the headteachers of two state schools who were asked to act in *loco parentis* in accordance with the guidelines of the British Psychological Society. The children were requested to respond anonymously to a multi-section inventory before their scheduled PE lesson. Having explained the purpose of the study, the principal investigator distributed the inventory and was on hand to help any participant who had questions pertaining to the wording or meaning of the questionnaire items. Additionally, it was emphasized to the participants that there were no right or wrong responses and that they should answer honestly regarding their feelings about PE. At this time, the participants were ensured about confidentiality and were also offered the option to withdraw from the study at any time without any negative repercussions. The inventory took approximately 20 min to complete.

Measures

Goal orientation

Individual differences in the proneness for task and ego involvement towards PE were assessed by responses to the Task and Ego Orientation in Sport Questionnaire (TEOSQ) (Duda and Nicholls, 1992). The questionnaire is a 13-item scale consisting of seven task (e.g. 'I learn a new skill by trying hard') and six ego items (e.g. 'I can do better than my friends'). In this instance, each participant responded to the stem 'I feel most successful in PE when . . .'. Responses were indicated on a 5-point Likert scale anchored by 1 ('strongly disagree') and 5 ('strongly agree'). The TEOSQ has demonstrated acceptable reliability with similar aged participants in previous PE research (Goudas *et al*., 1994; Vlachopoulos and Biddle, 1996).

Motivational climate

The participants' perceptions of the motivational climate were assessed using the English version of the 'L'Echelle de Perception du Climat Motivational' (EPCM) (Biddle *et al*., 1995). The EPCM is a 19-item self-report inventory developed to assess the extent to which students perceive their PE class climate to emphasize mastery/task goals or performance/ego goals. When completing the EPCM, the participants were requested to think about what their PE class is usually like, and respond to the stem 'In this PE class . . .'. An example item from the mastery subscale is 'the pupils are happy when they do their best to learn'. A performance subscale example is 'pupils try to do better than one another'. Responses were made on a 5-point Likert scale anchored by 1 ('strongly disagree') and 5 ('strongly agree'). The EPCM has demonstrated acceptable reliability in PE research with similar aged French school students (Biddle *et al*., 1995).

Perceived competence

Perceived competence towards PE was assessed using the five items from the perceived competence subscale of the 18-item Intrinsic Motivation Inventory (IMI) (McAuley *et al*., 1989). This version of the IMI represents the application to sport of the original IMI developed by Ryan and colleagues (Ryan, 1982; Ryan *et al*., 1983). In the present study, the stem was reworded to target the PE context. An example item from the competence subscale is 'I think I am pretty good at PE'. Responses were indicated on a 7-point Likert scale anchored by 1 ('strongly disagree') and 7 ('strongly agree'). The competence subscale of the IMI has demonstrated acceptable reliability with similar aged participants in previous PE research involving British children (Goudas and Biddle, 1994; Vlachopoulos and Biddle, 1996).

Motivational styles

Motivational regulations in PE were assessed by an adapted version of the Sport Motivation Scale (SMS) (Pelletier *et al*., 1995). The SMS is a 28-item inventory

subdivided into seven subscales that assess the multifaceted motivational regulations proposed by self-determination theory. These regulations consist of intrinsic motivation to know (e.g. 'For the fun of discovering new skills/techniques'), intrinsic motivation towards accomplishments (e.g. 'For the satisfaction I experience while I am perfecting my abilities'), intrinsic motivation to experience stimulation (e.g. 'For the excitement I feel when I am really involved in the activity'), identified regulation (e.g. 'Because it is one of the best ways I have chosen to develop other aspects of myself'), introjected regulation (e.g. 'Because I must do PE to feel good about myself'), external regulation (e.g. 'To show others that I am good at PE') and amotivation (e.g. 'I used to have good reasons for doing PE, but I am now asking myself why I have to'). Participants responded to the stem 'I do PE ...' on a 7-point scale ranging from 1 ('does not correspond at all' to 7 ('corresponds exactly'). Previous research in sport has provided support for the factor structure and reliability of this measure (Pelletier *et al.*, 1995; Li and Harmer, 1996).

Results

Descriptive statistics

Descriptive statistics and alpha coefficients (Cronbach, 1951) for all measures are presented in Table 1. Consistent with previous research that has used these inventories in physical activity settings, the data for all measures were computed and used in subsequent analyses in terms of mean scores. The sample reported relatively high scores for task orientation, mastery climate, performance climate, perceived competence and the three styles of intrinsic motivation. They also reported moderate scores for ego orientation, identified regulation, introjected regulation and external regulation. Finally, low scores were observed for amotivation.

Table 1 also shows the internal reliability for each measure. Most of the alpha coefficients were deemed acceptable based on Nunnally's (1978) criterion of 0.70, ranging from 0.70 to 0.85. The introjected regulation (0.66), external regulation (0.66) and amotivation (0.69) subscales of the SMS, however, exhibited alpha coefficients slightly below the criterion. Because of the close proximity of these scores to the 0.70 criterion and each construct's theoretical relevance, we retained these subscales in the present study. As such, results pertaining to these subscales should be interpreted with caution.

Psychometric properties of the scales

Since the EPCM and SMS were amended slightly to target the context of PE, we conducted a confirmatory factor analysis on both measures. Supporting the presence of two higher-order factor structures (namely mastery and performance), the results ($\chi^2_{147} = 378.89$, $P \leqslant 0.001$; CFI = 0.89; SRMR = 0.07; RMSEA = 0.07) revealed the EPCM to possess a tolerable fit to the data. The application of the SMS to the PE context also appeared reasonable based on the results of the confirmatory factor analysis ($\chi^2_{329} = 738.53$, $P \leqslant 0.001$; CFI = 0.92; SRMR = 0.07; RMSEA = 0.06). The results did, however, show that the external regulation subscale of the SMS deviated from the expected simplex pattern. That is, in contrast to the proposed simplex pattern (cf. Ryan and Connell, 1989), this subscale displayed positive relationships with motivational regulations characterized by high self-determination ($r = 0.70$–0.93). Because of concerns expressed about this subscale when measured by the SMS (see Standage *et al.*, 2003), and so as to avoid potentially spurious findings, we chose to eliminate it from further analyses. Subsequently, a confirmatory factor analysis on this revised covariance structure revealed slightly improved fit indices ($\chi^2_{237} = 554.80$, $P \leqslant 0.001$; CFI = 0.93; SRMR = 0.06; RMSEA = 0.06).

Correlational analysis

As shown in Table 2, task orientation was moderately correlated with self-determined styles of motivation (the three intrinsic motivations and identified regulation), perceptions of competence and perceptions of a mastery climate. Task orientation also shared a positive association with introjected regulation, and was negatively related to amotivation. With the exception of a significant negative relationship with amotivation, perceptions of a mastery climate shared the same, but generally weaker, pattern of associations as task orientation. Ego orientation was positively, yet marginally, associated with perceptions of competence, intrinsic motivation to know, intrinsic motivation towards accomplishments and perceptions of a performance climate. Ego and task orientation were positively related, although the correlation was rather weak. The perception of a performance climate was negatively linked to intrinsic motivation to know and competence. Finally, task orientation was positively related to perceptions of a mastery climate, while ego orientation was weakly associated with perceptions of a performance climate in a positive direction.

Hierarchical multiple regression analyses

Before the data analyses, each of the predictor variables (perceived competence, task orientation, ego orientation, mastery climate and performance climate) were centred (standardized) so as to avoid problems asso-

Table 1. Descriptive statistics and internal reliability of each measure

	Mean	*s*	Min–Max	Skewness	Kurtosis	Alpha
Task orientation	3.81	0.62	1–5	–0.763	0.695	0.81
Ego orientation	2.88	0.93	1–5	0.000	–0.699	0.85
Mastery climate	3.85	0.58	1–5	–0.412	0.420	0.80
Performance climate	3.45	0.59	1–5	–0.092	–0.384	0.74
Perceived competence	5.14	1.29	1–7	–0.666	–0.044	0.85
IM-stimulation	4.22	1.28	1–7	–0.114	–0.371	0.73
IM-accomplishment	4.26	1.25	1–7	–0.060	–0.263	0.72
IM-to know	4.30	1.31	1–7	–0.183	–0.381	0.80
Identified regulation	3.93	1.28	1–7	0.033	–0.283	0.70
Introjected regulation	3.94	1.32	1–7	0.051	–0.473	0.66
External regulation	3.82	1.28	1–7	–0.033	–0.436	0.66
Amotivation	2.83	1.29	1–7	0.533	–0.083	0.69

Note: IM = intrinsic motivation.

Table 2. Bivariate correlations among the study variables

	1	2	3	4	5	6	7	8	9	10	11
Task orientation (1)	—										
Ego orientation (2)	0.23	—									
Mastery climate (3)	0.31	0.05	—								
Performance climate (4)	–0.07	0.18	0.07	—							
Competence (5)	0.39	0.19	0.22	–0.11	—						
Intrinsic motivation-know (6)	0.48	0.07	0.32	–0.11	0.49	—					
Intrinsic motivation-stimulation (7)	0.40	0.12	0.29	–0.04	0.39	0.75	—				
Intrinsic motivation-accomplishments (8)	0.45	0.11	0.30	–0.02	0.41	0.78	0.72	—			
Identified regulation (9)	0.32	0.02	0.30	0.08	0.41	0.63	0.65	0.63	—		
Introjected regulation (10)	0.27	0.04	0.16	0.02	0.24	0.49	0.51	0.50	0.54	—	
Amotivation (11)	–0.20	–0.06	–0.05	0.08	–0.35	–0.24	–0.17	–0.27	–0.07	0.09	—

Note: Bivariate correlations of 0.11 and above are significant at $P < 0.05$; bivariate correlations of 0.14 and above are significant at $P < 0.01$.

ciated with unstandardized solutions such as main effect and interaction interdependence (cf. Aiken and West, 1991). Although the predictor variables were centred, the dependent variables remained uncentred. If one centres the dependent variables, this removes the original criterion of assessment and has no effect on regression coefficients in equations containing interactions (Aiken and West, 1991).

We conducted seven separate moderated hierarchical analyses. In these analyses, each subscale of the SMS served as the dependent variable. In each case, the five independent variables (main effects) were entered in step 1, the theoretically relevant two-way (or first-order) interaction terms (e.g. ego orientation × competence) in step 2 and the theoretically pertinent three-way (or second-order) interaction term (competence × ego orientation × performance climate) in step 3.

Consistent with the work of Newton and Duda (1999), we chose to adopt an approach where the significance of the *F*-ratio accompanying the change in variance (R^2) for each step indicated the significance of the addition of each group of independent variables to the regression equation. If the step was significant, then the *t*-values of each independent variable within the regression equation were assessed. In each regression analysis, the 0.05 level of significance was adopted.

Interaction effects

Drawing on the guidelines established by Cohen and Cohen (1983), Aiken and West (1991) outlined a procedure for plotting significant interactions which we adopted in the present study. Specifically, regression lines were chosen to represent varying levels of each independent variable, namely low and high (i.e. one standard deviation below the mean and one standard deviation above the mean). Substituting these values (i.e. $Z_L = -1$ and $Z_H = 1$) in the regression equation results in the derivation of a regression line for each level of an independent variable on another (e.g. each level of mastery climate regressed on each level of task orientation). In the present study, we used the values of $Z_L = -2$ and $Z_H = 2$ to facilitate the interpretation of each significant interaction. These values are then used to graphically depict, and also enable the evaluation of, each significant interaction. It is important to note, when significant interactions do emerge, the interaction between the variables in question should be plotted at the mean value of the other predictor variables included in the equation (since the independent variables are centred, $M = 0$) (Stephen West, personal communication, October 2001). Finally, when significant interactions did emerge, we used Aiken and West's (1991) procedure to calculate the effect size (f^2) of the interaction, the adequacy of our sample size for detecting such an effect (i.e. statistical power) and the approximate effect size after correcting for the effects of measurement error (disattenuated f^2) (see Aiken and West, 1991, table 8.4).

Intrinsic motivation to know

As Table 3 indicates, intrinsic motivation to know was predicted in a positive manner by the main effects of competence, task orientation and mastery climate. These variables accounted for 36% of the variance. The product of task orientation and mastery climate and the product of ego orientation and competence accounted for an additional 4% of variance (total $R^2 = 40\%$). The effect sizes for both of these interactions were small to moderate ($f^2 = 0.06$), the sample size requirement was $n = 95$ and the disattenuated f^2 was moderate ($f^2 = 0.15$). These significant interaction effects ($P < 0.05$) are shown in Fig. 1 and Fig. 2, respectively.

As shown in Fig. 1, when highly task-oriented students perceived a stronger mastery climate, their intrinsic motivation was higher. In contrast, high task-oriented students who perceived a low mastery climate reported lower intrinsic motivation. Although less pronounced, when task orientation was low, perceptions of a low mastery climate led to higher levels of reported intrinsic motivation than when a high mastery climate was perceived.

The second significant two-way interaction was the product of ego orientation and perceived competence. As shown in Fig. 2, when students were low in ego orientation, perceived competence did not moderate their reported intrinsic motivation. However, when ego orientation was high, perceived competence moderated the intrinsic motivation to know exhibited by the students. That is, when highly ego-oriented students perceived themselves to be competent in PE, their intrinsic motivation was higher. Similarly, if the perceived competence of high ego-oriented students was low, then intrinsic motivation was lower.

Intrinsic motivation to experience stimulation

Intrinsic motivation to experience stimulation was also predicted by the main effects of competence, task orientation and perceptions of a mastery climate. All emerged as positive predictors ($R^2 = 0.25$). The products of task orientation and mastery climate and of ego orientation and competence accounted for an additional 4% of the variance ($R^2 = 29\%$). The effect size for the interaction between task orientation and mastery climate was small to moderate ($f^2 = 0.06$), the sample size requirement was $n = 111$ and the disattenuated f^2 was moderate ($f^2 = 0.15$). As shown in Fig. 3, the

Table 3. Moderated hierarchical regression analysis for predicting motivational styles

Variable	*b*	*SE b*	*t*	Unique R^2
Intrinsic motivation to know				
Step 1				
Competence	0.35	0.05	6.95***	
Task	0.65	0.11	6.08***	
Mastery	0.35	0.11	3.29***	
				0.36***
Step 2				
Task × mastery	0.47	0.15	3.14**	
Ego × competence	0.13	0.05	2.16*	
				0.04**
Intrinsic motivation to experience stimulation				
Step 1				
Competence	0.26	0.05	4.92***	
Task	0.53	0.11	4.66***	
Mastery	0.32	0.11	2.80**	
				0.25***
Step 2				
Task × mastery	0.37	0.16	2.30*	
Ego × competence	0.14	0.05	2.62**	
				0.04*
Step 3				
Performance × ego × competence	–0.19	0.08	–2.35*	
				0.01*
Intrinsic motivation towards accomplishments				
Step 1				
Competence	0.28	0.05	5.26***	
Task	0.61	0.07	5.67***	
Mastery	0.31	0.11	2.85**	
				0.29***
Step 2				
Task × mastery	0.41	0.15	2.65**	
				0.04*
Identified regulation				
Step 1				
Competence	0.35	0.05	6.56***	
Task	0.35	0.11	3.16**	
Ego	–0.17	0.07	–2.41*	
Mastery	0.38	0.11	3.37***	
Performance	0.30	0.11	2.85**	
				0.26***
Introjected regulation				
Step 1				
Competence	0.16	0.06	2.71**	
Task	0.46	0.13	3.48***	
				0.10***
Amotivation				
Step 1				
Competence	–0.32	0.06	–5.57***	
				0.13***

*$P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

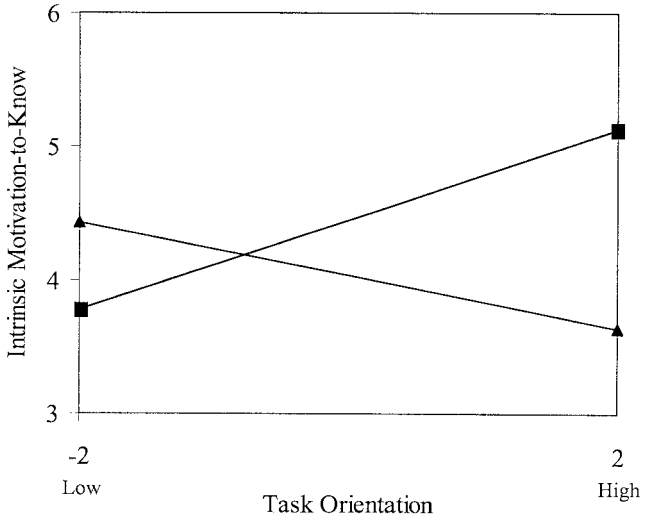

Fig. 1. Interactive effect of perceived mastery climate and task goal orientation on intrinsic motivation to know. ■, high mastery; ▲, low mastery.

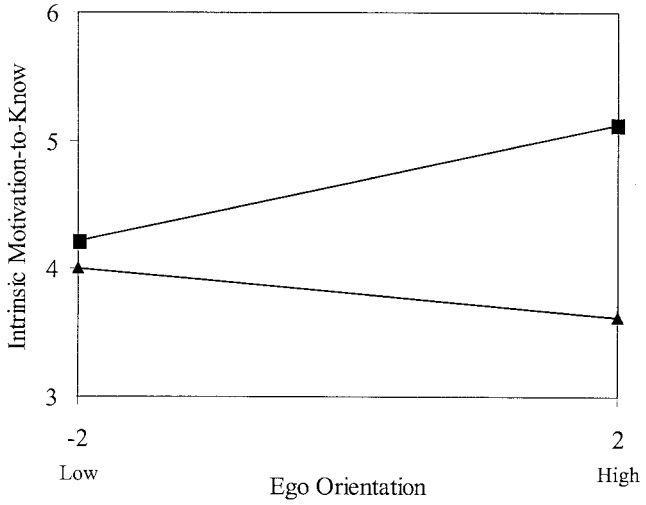

Fig. 2. Interactive effect of perceived competence and ego goal orientation on intrinsic motivation to know. ■, high competence; ▲, low competence.

nature of the task orientation × mastery climate interaction was similar to that for intrinsic motivation-to-know.

Although a significant ego orientation × perceived competence interaction effect again emerged, this first-order effect was superseded by a significant second-order interaction. Specifically, the product of performance climate, perceived competence and ego orientation predicted students' intrinsic motivation to experience stimulation. This three-way interaction accounted for a further 1% of the variance (total $R^2 = 30$). The effect size for the interaction was small

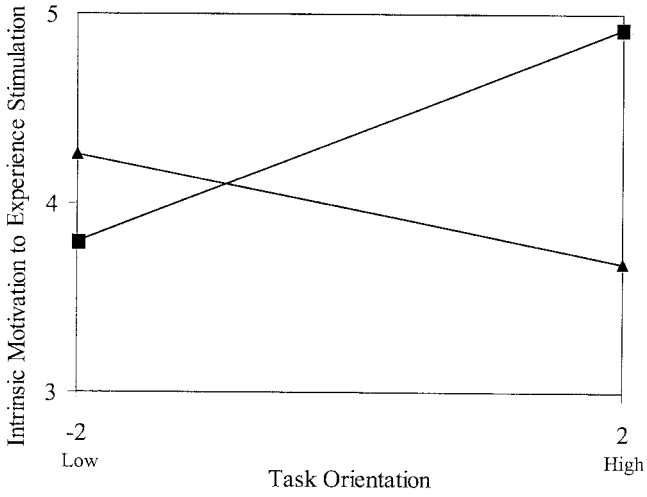

Fig. 3. Interactive effect of perceived mastery climate and task goal orientation on intrinsic motivation to experience stimulation. ■, high mastery; ▲, low mastery.

($f^2 = 0.01$), the sample size requirement was $n = 103$ and the disattenuated f^2 was small ($f^2 = 0.02$).

As shown in Fig. 4, this interaction revealed that when ego orientation was high, perceptions of competence moderated the intrinsic motivation experienced. When high ego-oriented students held perceptions of high competence, it was under conditions in which they perceived a low performance climate that the highest intrinsic motivation was reported. Under conditions in which such students perceived a high performance climate, intrinsic motivation was not enhanced even for those high ego-oriented students exhibiting high perceptions of competence.

Intrinsic motivation towards accomplishments

The predictive relationships for intrinsic motivation towards accomplishments were similar to the findings observed for the other two intrinsic motivation subscales. The main effects of competence, task orientation and mastery climate were significant positive predictors, accounting for 29% of the variance. Like the other two styles of intrinsic motivation, the interaction between task orientation and mastery climate was significant (unique $R^2 = 4\%$; total $R^2 = 0.33$). The effect size for the interaction was small to moderate ($f^2 = 0.06$), the sample size requirement was $n = 103$ and the disattenuated f^2 was moderate ($f^2 = 0.15$). As shown in Fig. 5, perceptions of a high mastery climate corresponded to heightened intrinsic motivation for those characterized by a high task orientation in PE. In this case, it was the students' task orientation that appeared to be the central construct in predicting the reported intrinsic motivation. It should be noted that the product of ego

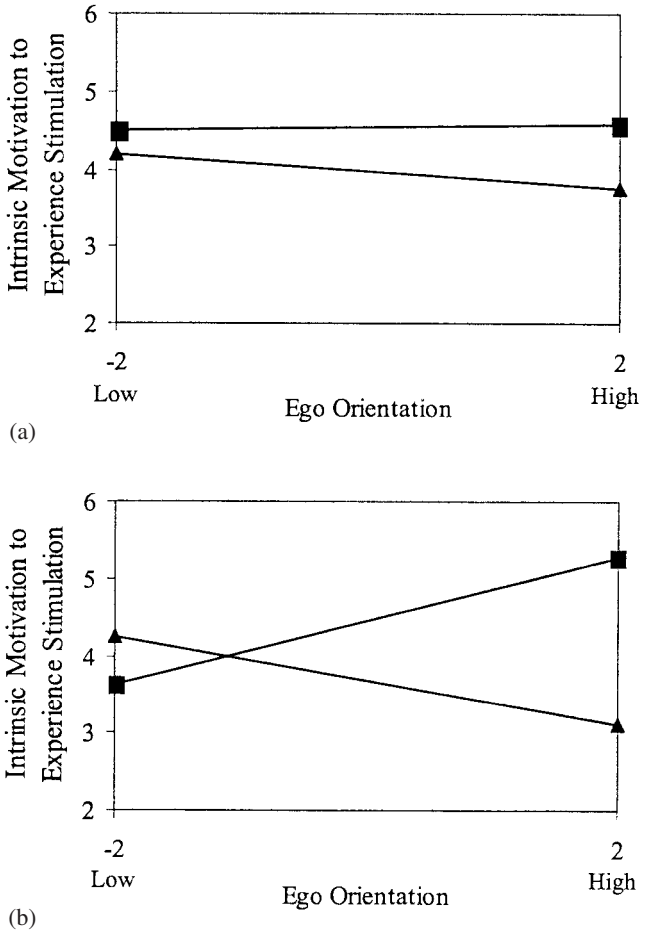

Fig. 4. Interactive effect of perceived performance climate, perceived competence and ego goal orientation on intrinsic motivation to experience stimulation: (a) high performance, (b) low performance. ■, high competence; ▲, low competence.

and competence marginally failed to account for additional variance in this type of intrinsic motivation ($P = 0.056$).

Identified regulation

The initial block of main effect variables accounted for 26% of the variance in identified regulation. Inspection of each variable's contribution revealed that perceived competence, task orientation, mastery climate and performance climate were positive predictors, whereas ego orientation was a negative predictor of identified regulation. None of the interaction terms reached statistical significance (Table 3).

Introjected regulation

Task goal orientation and perceived competence emerged as significant positive predictors of introjected regulation, accounting for 10% of the variance (Table 3). The various interaction terms failed to add significantly to the prediction of introjected regulation.

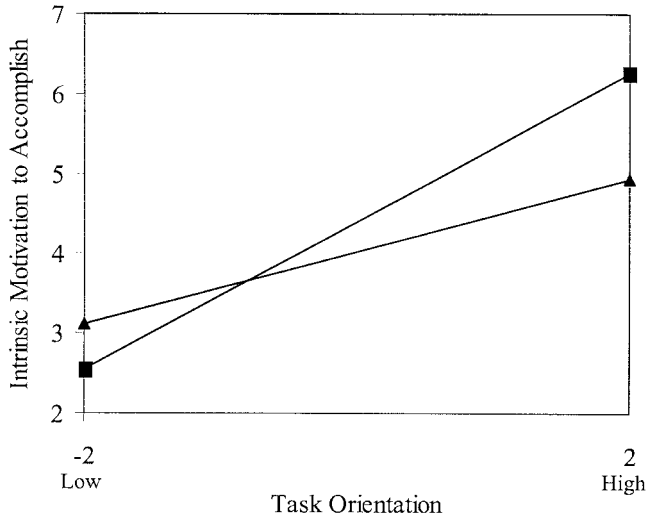

Fig. 5. Interactive effect of perceived mastery climate and task goal orientation on intrinsic motivation towards accomplishments. ■, high mastery; ▲, low mastery.

Amotivation

Competence was a negative predictor of amotivation, accounting for 13% of the variance (Table 3). The targeted interaction terms failed to add significantly to the prediction of amotivation.

Discussion

Achievement goal theory (Nicholls, 1984, 1989) suggests that goal involvement in achievement activities varies as a function of the interplay between goal orientations and situational factors (Dweck and Leggett, 1988; Nicholls, 1989). Nicholls (1989) also proposed that perceived ability needs to be considered in relation to the prediction of motivational patterns. Despite these theoretical propositions, and the successful application of the person × situation interaction approach to the study of motivational processes in sport settings (Swain and Harwood, 1996; Treasure and Roberts, 1998; Newton and Duda, 1999), no known research has adopted such an interactionist methodology in the context of PE. The aim of the present study was to examine the main and interactive effects of dispositional goal orientations, perceptions of the motivational climate and perceived competence on the motivational styles advanced by Deci and Ryan (1985, 1991).

As shown in Table 3, when significant interactions emerged, they explained little variance ($R^2 = 0.01–0.04$) above and beyond the independent contributions of the main effects. Interactive effects are difficult to detect in field-based work and seldom contribute more than 3% of explained variance (Chaplin, 1991). One of the main reasons for this is that measurement error has a large impact on the effect size of interactions (Aiken and West, 1991). In our study, after correction for measurement error the percentage of explained variance increased to about 10% and the effect sizes became moderate.

It is held that when significant interactions appear, they supersede main effects (cf. Cleary and Kessler, 1982). Nevertheless, given the percentage of variance accounted for by the main effects in the present study, the associated findings will be first discussed briefly with respect to past work and theoretical postulations. The second section of the discussion will address the significant interaction terms that emerged in relation to the three styles of intrinsic motivation. To this end, while the main effects accounted for the largest percentage of variance in reported intrinsic motivation scores, the interaction effects highlight the importance that the interplay between these constructs has for our understanding of the psychological processes which underpin motivational responses (Dweck and Leggett, 1988).

Main effects of goal orientations, perceptions of the motivational climate and perceived competence on different styles of motivation

In positively predicting the three styles of intrinsic motivation, the resulting main effects for task orientation and perceptions of a mastery climate were in accordance with achievement goal theory (Nicholls, 1989) and congruent with previous PE-based work (cf. Biddle, 2001). That is, an examination of the main effects adds support to a cogent body of literature that has demonstrated that independently holding a self-referenced criterion for success, or the view that one's environment supports learning, effort and personal improvement, fosters intrinsic motivation towards PE.

Task orientation emerged as a positive predictor of identified regulation. To this end, students that hold a self-referenced criterion for success may be more likely to absorb and embrace PE as personally important. Such identification could permit students to participate in PE because they understand the worth of PE activities and actively desire their repercussions. It would be interesting to discover whether such *identification* provides a buffering effect for high task-oriented students. That is, does this activity valuation permit the student to maintain self-determined motivation in instances where their intrinsic motivation wavers (e.g. 'I don't think I will enjoy PE today, but I know it is good for me so I want to partake')?

Ego orientation emerged as a negative predictor of identified regulation. Perhaps aligned with the sport-based work of Duda *et al.* (1992), who found ego orientation to be positively related to work avoidance and unrelated to interest, high ego-oriented students in PE may play down the personal relevance of this activity as a self-protective strategy should they not demonstrate superior ability relative to their peers.

Despite theoretical arguments which posit that introjected regulation should be related to the concept of ego involvement (Ryan and Deci, 2000), task orientation emerged as a positive predictor of this type of extrinsic motivation in the current study. Introjected regulation represents a less self-determined form of extrinsic motivation where the regulation of behaviour is characterized by a shift from external pressures (e.g. rewards) to self-imposed sanctions such as self-guilt. For example, a student would be exhibiting introjected regulation if she was to attend a swimming practice during her lunch break not because she enjoys swimming, but because she would feel guilty if she were not to attend. Previous cross-sectional work in the context of education has shown a positive association between introjected regulation and positive (and also negative) motivational indices (Ryan and Connell, 1989). With respect to the current findings, PE is a context in which it makes sense that task orientation could be positively related to introjected motives at least in the short term. In modern society, an active engagement in PE represents a desirable behaviour for many students, as PE has recently been targeted by many governmental and professional organizations as a vehicle to enhance public health (cf. Biddle *et al.*, 1998). Additionally, it has long been advanced that 'practice makes perfect', a proclamation that underscores principles embedded in task orientation, namely effort and learning. Thus, it makes sense that inner feelings of guilt may occur, even for high task-oriented students, should they withdraw or abstain from PE. It is important to note that the introjected motivation in this case would not be guided by the seeking of approval from others, but rather by a self-referenced disparagement initiated by a type of 'responsibility guilt'. This guilt may stem from missing both the chance to enjoy PE classes and/or forego the associated benefits that PE offers. Future research exploring the motivational significance of introjected regulation would benefit from adopting longitudinal designs. Such an approach would allow researchers to examine two intriguing questions. First, can introjected regulation serve as an important mechanism for initial involvement (via internal prods) and be subsequently

internalized over time to foster intrinsic motivation and adaptive engagement (i.e. maintenance in terms of the activity at hand)? Second, if an individual fails to internalize these intrapersonal introjected regulations across time, does his or her motivation and subsequent well-being suffer?

In accordance with previous PE work (Ntoumanis, 2001b), perceived competence emerged as a positive predictor of self-determined styles of motivational regulation, namely the three intrinsic motivations and identified regulation. The present findings are also aligned with Deci and Ryan's (1985, 1991, 2000) assertion that competence is an important nutriment of self-determined motivation. Equally consistent with the predictions of self-determination theory (Deci and Ryan, 1985, 1991) and past research (Ntoumanis, 2001b), amotivation was negatively predicted by perceptions of competence. Students that perceived themselves to be lacking in PE-related competence were more likely to believe that there is little or no reason to engage in PE. This latter finding is theoretically coherent, as amotivated students are assumed to have a lack of belief in their ability because they do not perceive a contingency between their efforts and performance outcomes. Like people labelled 'learned helpless' (Seligman, 1975), the students' motivation and behavioural intention are thwarted. The observed negative relationship between perceived competence and amotivation also supports the empirical work of Pelletier *et al*. (1999), who identified *lack of ability beliefs* to be one of four components to underlie amotivation. All in all, the findings relating to the main effect for perceived competence on facets of self-determined motivation and amotivation suggest that both PE teachers and educational administrators would be wise to design, structure and operate the PE curriculum so that perceptions of competence are fostered.

Consistent with previous research (Brunel, 1999), the present results revealed that perceptions of a mastery-oriented climate positively predicted identified regulation. This finding suggests that students have much to gain motivationally from an environment that promotes learning, effort and personal improvement, as such situational cues appear to foster self-initiated and valued engagement in PE.

Interactive effects of perceptions of the motivational climate, goal orientations and perceived competence on different styles of motivation

In addition to the main effects, four significant two-way interactions and one significant three-way interaction emerged to predict indices of students' intrinsic motivation. As is apparent from Figs 1 and 3, the interactive effects between task orientation and perceptions of a mastery climate in predicting intrinsic motivation to know and intrinsic motivation to experience stimulation were very similar. As such, these findings will be discussed concurrently. A third interaction between task orientation and perceptions of a mastery climate predicted intrinsic motivation towards accomplishments. The nature of this interaction differed somewhat and, as a result, this interaction will be discussed separately (see Fig. 5).

Previous sport-based work (e.g. Swain and Harwood, 1996; Treasure and Roberts, 1998; Newton and Duda, 1999) has provided some support for Dweck and Leggett's (1988) contention that perceptions of pronounced motivational climates may override an individual's goal orientation (especially if weak) with respect to the prediction of motivational indices. In the present study, however, the moderating effects of the climate did not hold as proposed. Indeed, rather than altering the reported intrinsic motivation of students when their task goal orientation was weak, it was when the students' task orientation was high that the climate served to influence intrinsic motivation to experience stimulation and intrinsic motivation to know. Previous PE work has shown perceptions of a mastery climate and task orientation to independently foster intrinsic motivation (see Biddle, 2001, for a review). The present findings revealed the intrinsic motivation of high task-oriented students to be enhanced when situational cues were perceived to be high in mastery features. This consistency between dispositional and perceived situationally emphasized goals may have accentuated the students' reliance on self-referenced criteria for success and, as such, reinforced that the engagement in activities is a means to an end in and of itself (Nicholls, 1989). Contrary findings were observed for high task-oriented individuals who perceived a low mastery climate. These students reported lower scores on the two indices of intrinsic motivation. For these students, it may be that they do not feel that environments low in mastery cues support their own subjective view that competence is demonstrated through self-referenced gains and, as such, do not offer either the challenge and/or required foci to sustain intrinsic involvement.

Although not as highly pronounced as for high task-oriented students, students low in task orientation reported higher intrinsic motivation to experience stimulation and intrinsic motivation to know when they perceived a low mastery environment as opposed to one high in mastery features. Congruent with previous suggestions (e.g. Treasure and Roberts, 1998) and empirical work in the sport domain (e.g. Ntoumanis and Biddle, 1998; Treasure and Standage, 1999), the present findings suggest that individuals may hold more intrinsic investment in environments that are consistent

with their own personal theory of achievement at least in the short term. The present study, however, does not entirely support this 'matching hypothesis' (Pervin, 1968). That is, a conceptually similar pattern of findings did not emerge for the interplay between ego-orientation and perceptions of a performance climate. It would be interesting for future work to examine the motivational significance of the compatibility between goal orientations and perceptions of the climate in PE over time. That is, using longitudinal designs, research may wish to examine Ames' (1992a,b) suggestion that task orientation should be fostered by long-term exposure to mastery climates, while performance climate should encourage the development of an ego orientation. In light of previous propositions that exposure to performance-oriented climates over time should make it likely that 'at-risk' students will adopt maladaptive learning strategies (Nicholls, 1989; Ames, 1992a), longitudinal research would do well to also include behavioural indicators of motivation (e.g. measures of persistence).

In predicting intrinsic motivation to accomplish, the interaction between task orientation and perceptions of a mastery-oriented climate was somewhat different from the task orientation × mastery climate interaction effects on intrinsic motivation to know and intrinsic motivation to experience stimulation. This interaction effect showed that when task orientation was low, differences in a mastery-oriented climate did not result in marked differences in intrinsic motivation scores. However, when task orientation was high, differences in perceptions of a mastery climate resulted in comparatively larger discrepancies in intrinsic motivation scores. Specifically, the highest intrinsic motivation was reported when high task orientation complemented a climate perceived as high in mastery salient cues. With this interaction, however, high task-oriented students who perceived a low mastery climate reported higher intrinsic motivation scores than their low task-oriented counterparts irrespective of the extent to which these students perceived a mastery climate. This finding is congruent with a meta-analysis conducted by Ntoumanis and Biddle (1999), who reported that task orientation is related to adaptive outcomes in physical activity, and supports Nicholls' (1984, 1989) contention that the quest for task mastery leads to increases in intrinsic interest.

In line with the predictions of achievement goal theorists (e.g. Dweck, 1986; Dweck and Leggett, 1988; Nicholls, 1989), who have argued that perceptions of ability will moderate the achievement strivings of those endorsing normative criteria for success, perceptions of competence interacted with ego orientation in the present study to moderate students' intrinsic motivation to know. The resulting interaction revealed that for high ego-oriented students, perceptions of competence served as a critical construct in guiding their motivational responses. That is, highly ego-oriented students who perceived their competence to be high reported greater intrinsic motivation than high ego-oriented students with low perceptions of competence. Moreover, and equally aligned with the tenets of achievement goal theory (Nicholls, 1984, 1989), the present findings showed that for students with low ego orientation, perceptions of competence had little bearing on their intrinsic motivation. Collectively, these findings support the stance that when an ego goal (or normative success criterion) predominates, differences in perceived ability are more likely to result in variability in motivational striving. In congruence with Nicholls' (1989) thinking, it appears that the cost of doubting one's competence is more severe when an ego goal prevails.

A significant three-way interaction between perceptions of a performance climate, perceived competence and ego orientation emerged to predict students' intrinsic motivation to experience stimulation. The nature of this interaction was not consistent with our hypothesis. Rather, the interaction revealed that under conditions when students perceived a low performance climate and ego orientation was high, perceptions of competence moderated the amount of intrinsic motivation to experience stimulation reported. However, when perceptions of a performance climate were pronounced, the interaction effect was ordinal in nature. That is, at all levels of ego orientation and perceived performance climate, students who reported higher perceived competence had higher scores for intrinsic motivation to experience stimulation. The interaction also shows that when a pronounced performance climate is perceived, the intrinsic motivation of highly ego-oriented students with high perceived PE competence reaches a plateau. With respect to this latter finding, although performance or ego-involving cues make competence judgements more salient, the diverse activities encountered in PE may make it difficult for even the more physically able (and highly ego-oriented) students to be seen as the 'best' at all activities. Such questions about the adequacy of one's competence should have implications for the amount of intrinsic motivation experienced.

When examining the motivational implications of being both task- and ego-oriented to different extents, many studies of sport and PE have adopted a goal profile approach (e.g. Vlachopoulos and Biddle, 1996; Dorobantu and Biddle, 1997; Standage and Treasure, 2002). When researchers employ this analysis, four groups are created based usually on scores of central tendency for task and ego orientation (cf. Biddle, 2001; Duda, 2001). In adopting such an analysis, researchers assume a significant interaction exists between task and ego goal orientation (Duda, 2001). It should be noted

that, in the present work, we did not find support for the predicted interaction between task and ego orientation in relation to the prediction of the various motivational regulations. Such a result suggests that researchers should ascertain whether a significant task × ego orientation interaction exists before proceeding towards goal profile analyses.

Conclusion and future directions

The present study was a preliminary investigation of the independent and interactive properties of perceptions of the motivational climate, dispositional goal orientations and perceived competence in predicting student motivation in PE. In addition to main effects that were largely consistent with the tenets of achievement goal theory (Nicholls, 1984, 1989), significant interaction effects emerged. The latter support the adoption of a person × situation interaction approach to the study of motivational regulations in the context of PE. Indeed, consistent with previous work on sport (Swain and Harwood, 1996; Treasure and Roberts, 1998; Newton and Duda, 1999), the present results imply that not only is the person × situation approach beneficial to our understanding of motivational processes in PE, but the sole adoption of a dispositional or situational approach may result in an incomplete picture. That is, although the independent effects accounted for most of the variance in predicting the motivational regulations, it would appear that researchers need to consider the interplay of situational and individual difference variables when studying the antecedents of student motivation in PE (Treasure and Roberts, 2001). In light of the proposed moderating effect of the climate on achievement goal orientations, longitudinal studies would provide much insight into the interplay between these variables in 'real-world' PE settings.

Acknowledgements

This article stems from data that formed a portion of the first author's doctoral dissertation at the University of Birmingham, UK. We would like to thank David Markland and two anonymous reviewers for their helpful and constructive comments on previous drafts of the manuscript.

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