JOURNAL OF SPORT & EXERCISE PSYCHOLOGY, 2003, **25**, 284-306

A Meta-Analysis of Perceived Locus of Causality in Exercise, Sport, and Physical Education Contexts

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The present article conducts a meta-analytic review of the research adopting the perceived locus of causality in the contexts of sport, exercise, and physical education. A literature search of published articles identified three main research foci: (a) the development of instruments that assess perceived locus of causality; (b) examination of the construct validity of perceived locus of causality by investigating the relevance of the self-determination continuum as well as by using antecedents (e.g., perceived competence) and outcomes (e.g., intentions); and (c) integration of Nicholls' (1984) concepts of task and ego orientation with perceived locus of causality. A meta-analysis using 21 published articles supported the existence of a self-determination continuum from external regulation to introjection and identification. In addition, path analysis of corrected effect sizes supported the mediating effects of perceived locus of causality on the relationship between perceived competence and intentions. Results are discussed with reference to the assumptions of self-determination theory, Vallerand's (1997) hierarchical model of intrinsic/extrinsic motivation, and theories of behavioral intentions.

Key Words: self-determination theory, perceived competence, behavioral intentions

Understanding adherence to health-related behaviors is an important avenue for scientific inquiry. Knowledge of the fundamental processes and mechanisms of human behavior can inform practice about how to promote human motivation. Deci and Ryan's (1985) self-determination theory has become increasingly popular in studies of human motivation (Deci, Koestner, & Ryan, 1999a).

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Self-Determination Theory

Its Approach to Human Behavior

Self-determination theory postulates that intentional human behavior can be described, in a parsimonious way, through two processes of intrinsic motivation and internalization. Intrinsic motivation refers to "the doing of an activity for its inherent satisfactions rather than for some separable consequences" (Ryan & Deci, 2000, p. 56). Cognitive evaluation is a sub-theory of self-determination theory that attempts to understand factors that facilitate and undermine intrinsic motivation. It has been postulated that intrinsic motivation is engendered when people are in conditions that support three innate psychological needs: the need for self-determination, competence, and relatedness (Ryan & Deci, 2000). Self-determination refers to the need to initiate and regulate one's own actions. Competence refers to the need to produce behavioral outcomes and to understand production of these behavioral outcomes. Relatedness refers to the need to have satisfactory relationships with others and with the social order in general (Deci & Ryan, 1990).

In a meta-analysis of experimental studies dealing with intrinsic motivation, Deci et al. (1999a) established a relationship between experimental conditions influencing psychological needs and intrinsic motivation. In the experiments they meta-analyzed, they assessed intrinsic motivation after exposing individuals to conditions that either frustrated or satisfied psychological needs. The psychological need for self-determination was manipulated by exposing individuals to conditions of either choice or no choice. In addition, the need for competence was manipulated by giving positive or negative feedback.

Following exposure to such conditions, participants' levels of intrinsic motivation were assessed in two ways. First, engagement in a target task during which individuals were allowed to engage in alternative interesting tasks (free-choice period) was used to represent a behavioral indicator of intrinsic motivation. Second, a self-report measure of interest derived from the task chosen during the free-choice period was used as a more covert measure of intrinsic motivation. Deci et al. (1999a) reported that conditions which frustrated psychological needs undermined self-reported interest and overt involvement with the target task when compared to conditions that facilitated the satisfaction of such needs. In addition, there is evidence that intrinsically motivated behaviors are intentional. Chaiken (1980) showed that people are more likely to express intentions to search information about a topic when the topic is personally interesting to them vs. when it is not (Chatzisarantis, Hagger, Biddle, & Karageorghis, 2002).

Although the concept of intrinsic motivation has attracted a great deal of scientific interest and debate (see Eisenberg, Pierce, & Cameron, 2000), behavioral regulation through intrinsic motivation is not the only type of social behavior that individuals can engage in. For this reason, Deci and Ryan (1985) proposed an organismic integration theory, which is a second sub-theory of self-determination theory, to explain the process of internalization. Internalization is the process through which individuals take in a value or regulation and progressively transform it so that the regulation emanates from their own sense of self.

A model describing internalization and human motivation from an organismic integration theory perspective is shown in Figure 1a. On the left side is amotivation, referring to a person's lack of intentionality and sense of personal

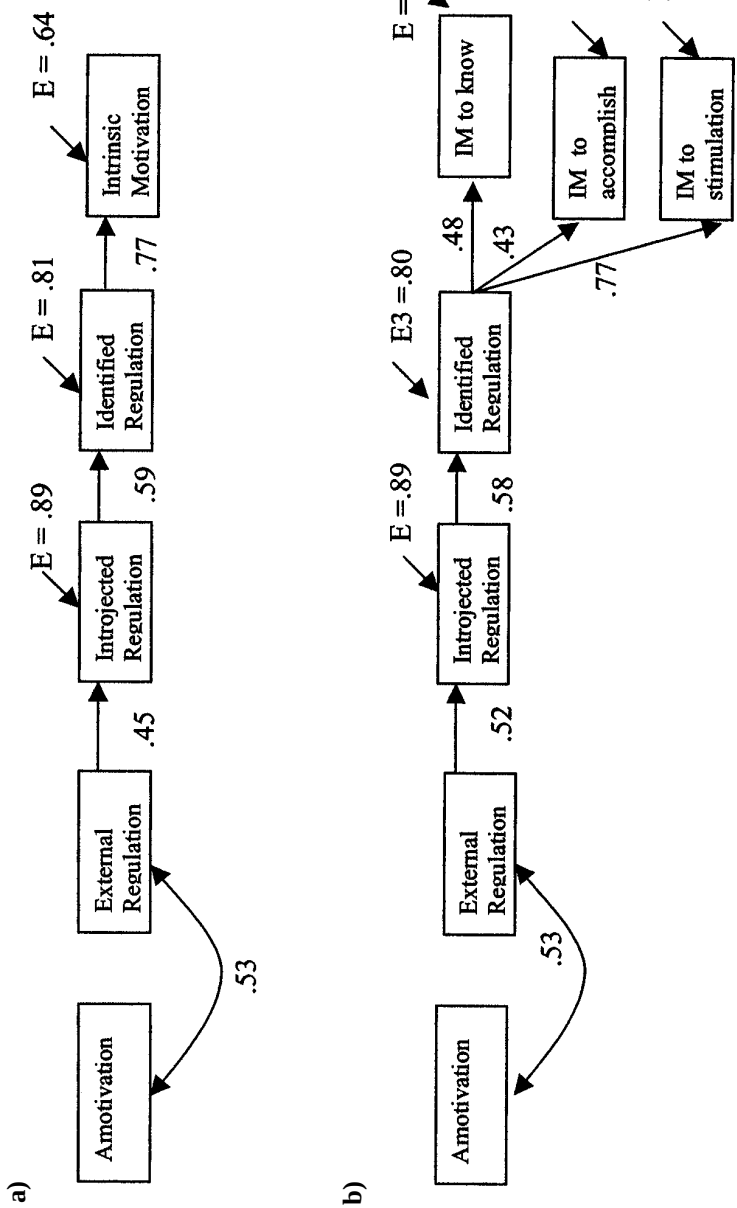

Figure 1 — (a and b). Simplex order structure of PLOC. Integration not featured because very few studies included measures of integration in PLOC scale. *Note:* **Identified regulation is a dependent variable, therefore covariances between identification and intrinsic motivation cannot be estimated. For this reason, paths are specified from identification to intrinsic motivation.**

causation. Perceived incompetence and beliefs that behavior cannot reliably lead to desired outcomes can precipitate amotivation. To the right of amotivation on the self-determination theory continuum are four forms of extrinsic motivation: external regulation, introjection, identification, and integration. Each form of regulation reflects the achievement of outcomes that are separate from the behavior, which is why they do not represent intrinsic motivation. Even so, they do reflect different degrees of internalization.

Internalization is initialized by significant others to whom one feels attached or related (Ryan & Deci, 2000). These externally prompted behaviors are represented by external regulation. Introjection lies next to external regulation and refers to a behavior performed in order to avoid a pressuring emotion of guilt or shame. External regulation and introjection describe less internalized and more controlling forms of behavior because they refer to behaviors performed under internal (i.e., introjection) or external pressure (i.e., external regulation). A less controlling and more autonomous form of behavior is described by identification, a behavior that is performed because the individual values it. During identification, individuals accept and endorse the value of behavior as a reason for action, thus, identified behavior reflects higher degrees of internalization.

The most autonomous and least controlling form of behavior is integrated regulation, which refers to identifications that one brings into congruence with other behaviors and roles he or she enacts in life. This definition of integrated regulation presupposes that identification is a less autonomous form of behavioral regulation than integration, because regulation through identification may conflict with preexisting values and behaviors. In their study, Deci, Eghrari, Patrick, and Leone (1994) established a relationship between experimental conditions that influence psychological needs and internalization of an initially boring activity. In this experiment, the provision of a rationale, acknowledgement of tension and pressure associated with involvement in a boring activity, provision of choice, and use of nonpressuring language (e.g., "may" or "could" vs. "should" or "must") were all found to facilitate internalization.

Ryan and Connell (1989) developed an instrument, in an educational context, termed the Perceived Locus of Causality scale (PLOC). The PLOC measures external regulation, introjection, identification, and intrinsic motivation. These dimensions of the PLOC scale were also found to conform to a simplex-ordered structure. A simplex-ordered structure is evident when correlations between adjacent types of behavior (e.g., external regulation and introjection) are higher than correlations between dimensions that lie further apart (e.g., external regulation and identification). Furthermore, simplex-ordered correlation matrices indicate the presence of a continuum, which Deci and Ryan (1990) describe as a *developmental continuum of self-determination*. However, Ryan and Deci (2000) also suggest that support of a continuum does not preclude the possibility for individuals to internalize a new behavior at any point along this continuum, depending on prior experience and current situational factors.

Applications in Sport, Exercise, and Physical Education

The concept of PLOC provides a very comprehensive view of human motivation. As Ryan and Deci (2000) put it, "even a brief reflection suggests that motivation is hardly a unitary phenomenon" (p. 54), yet many theories of intentional behavior still define and operationalize motivation as a unitary phenomenon

(Bagozzi & Kimmel, 1995). In sport, exercise, and physical education contexts, research has dealt with the development and examination of construct validity of instruments that measure intrinsic motivation and internalization. A number of studies have also examined relationships between measures of PLOC and Nicholls' (1984) achievement goals theory (Biddle, Soos, & Chatzisarantis, 1999; Goudas, Biddle, & Fox, 1994; Ntoumanis 2001b; Wang, Chatzisarantis, Spray, & Biddle, 2002).

With regard to measurement issues, there is a French version of the Sport Motivation Scale (SMS), developed by Briere, Vallerand, Blais, and Pelletier (1995) and translated into English by Pelletier, Fortier, Vallerand, Tuson, and Blais (1995); translated into Bulgarian by Chantal, Guay, and Martinova (1996); and translated into Greek by Georgiadis, Biddle, and Chatzisarantis (2001). The Sport Motivation Scale assesses amotivation, external regulation, introjection, identification, and three types of intrinsic motivation: to know (e.g., "for the pleasure it gives me to know more about the sport that I practice"); to accomplish (e.g., "because I feel a lot of personal satisfaction while mastering certain difficult movements"); and to experience stimulation (e.g., "for the intense emotions"). In the context of physical activity is a Behavioral Regulation in Exercise Questionnaire (BREQ) developed by Mullen, Markland, and Ingledew (1997), and the Exercise Motivation Scale (EMS) developed by Li (1999). Finally, Goudas et al. (1994) adapted Ryan and Connell's (1989) Self-Regulation Questionnaire as well as Vallerand, Pelletier, and Blais et al.'s (1992) Academic Motivation Scale in the physical education context. This PLOC scale for physical education measures external regulation, introjection, identification, and intrinsic motivation, but not integrated regulation.

Despite differences in measurement, correlations between different types of behavior, described by PLOC, have been shown to conform to a simplex-ordered structure. Therefore, studies do support the hypothesized self-determination continuum. However, studies have predominantly used a visual inspection of correlations (observed, or correlations corrected for attenuation) in inferring the presence of the continuum. An observed correlation matrix is simplex-ordered when a model specifying linear dependencies between adjacent dimensions only, and not between nonadjacent dimensions, explains the observed correlation matrix satisfactorily (Joreskog, 1970). Tests of this kind can be conducted with structural equation modeling techniques, on a LISREL or EQS interface. In the sport context, only two studies, Li and Harmer (1996) and Li (1999), confirmed the simplex pattern of the Sport Motivation Scale and the Exercise Motivation Scale through structural equation modeling techniques. Thus it is not yet known whether a simplex model can represent results (i.e., correlations) from studies using PLOC in the contexts of sport, exercise, and physical education.

Research on sport has also explored associations between PLOC and other psychological variables in an attempt to examine the construct validity of PLOC. Briere et al. (1995) and Pelletier et al. (1995) found positive correlations between more autonomous forms of behavior (identification and intrinsic motivation) with hypothesized determinant (e.g., perceived autonomy, competence) and outcome variables (e.g., effort, intentions). Moreover, in the context of physical education, Goudas et al. (1994) found associations between PLOC and Nicholls' (1984) concepts of task and ego orientation (see also Ntoumanis, 2001b). Two studies pointed

to positive relationships between perceived relatedness, autonomy, and PLOC (Li, 1999; Ntoumanis, 2001a). This empirical evidence supports the construct validity of PLOC because PLOC is correlated with hypothesized determinant and outcome variables (Briere et al., 1995; Goudas et al., 1994; Pelletier et al., 1995). However, correlational studies also raise an important question about the role of PLOC in the prediction and explanation of physical activity.

In the physical education context, research has addressed this question but yielded equivocal results. Using path analysis, Goudas et al. (1994) found perceived competence to mediate the effects of PLOC and of task and ego orientations on intentions. However, Goudas, Biddle, and Underwood (1995) also point out that perceived competence covaries with PLOC in predicting intentions. Yet, in another study Biddle et al. (1999) found PLOC to mediate effects of perceived competence and of task and ego orientation on intentions (Ntoumanis 2001a). Hence the role of PLOC in predicting and explaining physical activity is still an open question.

Research Hypotheses

The present study examines the adequacy of three models in explaining results from studies using PLOC and other psychological antecedents and outcomes of physical activity. The adequacy of the models is tested through a combination of meta-analytic and path-analytic techniques (Hunter & Schmidt, 1990; Tett & Meyer, 1993). Meta-analytic applications permit researchers to make inferences about a relationship after correcting correlation coefficients and variance of correlations for statistical artifacts of sampling error and measurement error (reliability). The logic of meta-analysis is that, in many instances, equivocal results are published because of statistical artifacts (sampling and measurement error), and controlling for such statistical artifacts permits more accurate inferences about a set of relationships.

The present study will correct two correlation matrices for sampling error and measurement error by using a model of random effect sizes (Schmidt & Hunter, 1999). The first meta-analysis will correct correlations and variance of correlations between dimensions of PLOC. Whether or not the corrected correlations between dimensions of PLOC conform to a simplex-ordered structure will then be examined through path analysis. Given that in the exercise and sport psychology literature, intrinsic motivation is operationally defined as either one- or three-dimensional, the adequacy of a one-dimensional and a three-dimensional model in explaining correlation matrices will be examined (see Figure 1).

The second meta-analysis will correct correlation coefficients and variance of correlations between PLOC, perceived competence, and intentions. The extent to which PLOC mediates the effects of perceived competence on intentions will then be examined using path analysis (Figure 2). The present study will not meta-analyze the relationships between perceived autonomy, relatedness, and PLOC, since only a few studies employed measures of relatedness and autonomy. Because contemporary research has treated perceived competence as an antecedent of PLOC and intentions as an outcome variable (Briere et al., 1995; Pellettier et al., 1995; Vallerand, 1997), it is hypothesized that PLOC will mediate the effects of perceived competence on intentions. This final hypothesis reflects our interpretation of Deci and Ryan's (1985) self-determination theory.

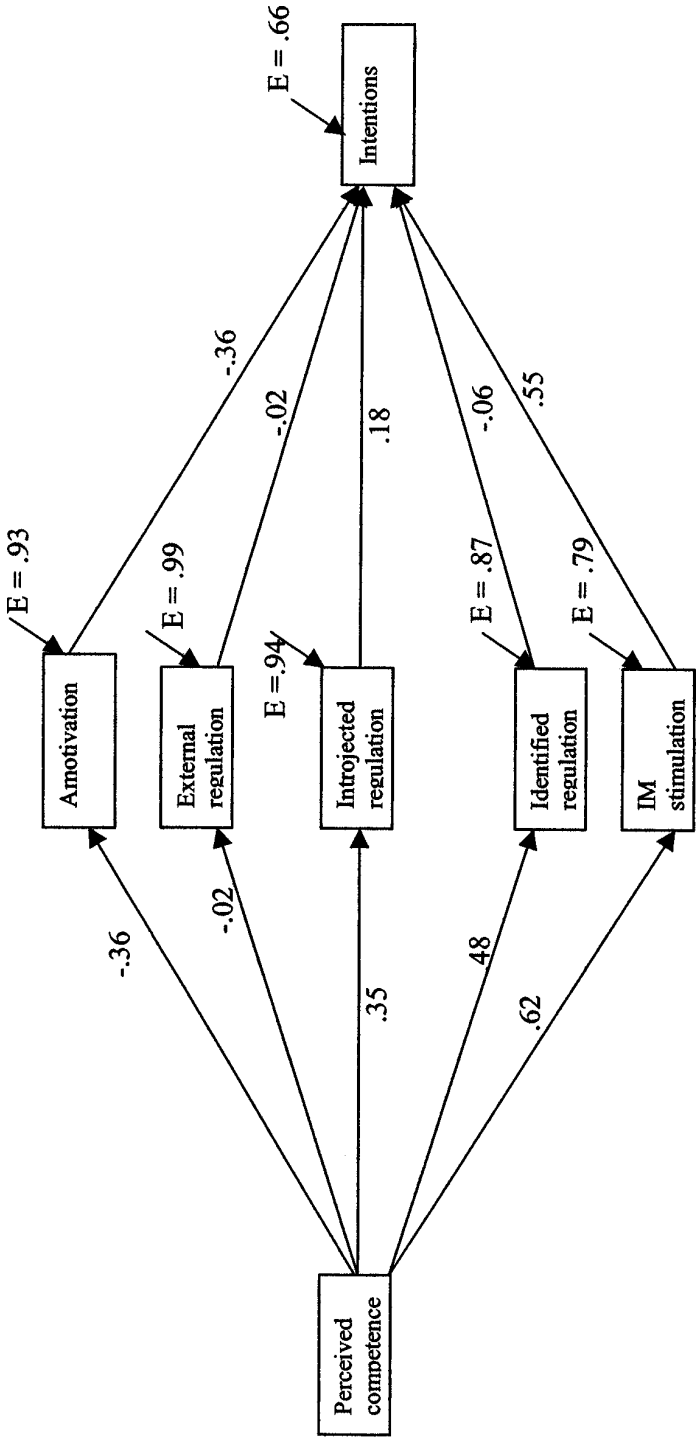

Figure 2 — A model showing antecedents and outcomes of PLOC.

Method

Selection of Studies

We conducted an electronic CD-ROM search using the following key words: self-determination theory, organismic-integration theory, perceived locus of causality, self-determination continuum, autonomy continuum, physical exercise, sport, athletics, physical education classes, school, and classroom. We used the following databases: *Sport Discus* (1974–2001), *Psychlit* (1974–2003), *ERIC* and *British Educational Index* (1974 to 2003), *Australian Educational Index* (1978 to 2003) and *Canadian Educational Index* (1976 to 2003), and the *Index to Theses*. We used Ryan and Deci's (2000) review and the meta-analysis conducted by Deci, Koestner, and Ryan (1999a, 1999b) to locate other articles that might not have been included in the electronic databases.

From the pool of articles using the self-determination theory, studies were rejected on the basis of three criteria: (a) did not include statistical data; (b) did not use measures of PLOC; and (c) did not use at least two dimensions of PLOC (see Markland & Hardy, 1997). Based on these criteria, we subjected the results from 21 articles to statistical analysis. The studies are presented in Table 1. Meta-analytic correlations between dimensions of PLOC and competence, intentions, and PLOC were estimated on the basis of cross-sectional observations. Note that meta-analyses which include a small number of studies are as important as those which include large number of studies, given that they can be used to conduct second-order meta-analysis (Hunter & Schmidt, 1990; Schmidt, 1996). However, when meta-analyzing a small number of studies, it is important to control for inflated Type I error rates that the Hunter and Schmidt meta-analysis procedure produces (Field, 2001). In the present meta-analysis, the predicted Type I error rates of relationships that are hypothesized to be significant range from .07 for the external regulation/introjection relationship to .15 for the introjection/intrinsic-motivation-to-know relationship. To reduce Type I error rates, we accepted a correlation as significant when it was three times as large as its respective standard error (Field, 2001).

Statistical Analysis

The present meta-analysis gathered information from each study in terms of sample size, reliability, age, gender, purpose, context, design, measures used in the study, and type of PLOC measure. Based on sample and reliability information, we corrected the correlation coefficients of each study and variance of correlations across studies for sampling error and measurement error. Correlations were not corrected for restriction or enhancement in range because there is not a normative study reporting the population standard deviations of PLOC (Hunter & Schmidt, 1990). We attempted to retrieve as much information as possible from authors (via email) and/or to estimate correlation coefficients from statistics as reported in the articles. Not all the required statistical information could be obtained, and therefore results of the present meta-analyses were based on distributions of correlation coefficients and of reliability information. According to Hunter, Schmidt, and Jackson (1982), such meta-analysis is as accurate as meta-analysis using complete information.

Table 1 Characteristics of Studies Using Measures of PLOC

Studies Age of participants	Sample size	Purpose	Context	Design	Measures used	Measures of PLOC
Biddle et al. (1999) 12–16 yrs	*N* = 723	Look at physical activity intentions from a goals & self-determination theory perspective	Sport & physical education	Cross-sectional	Task & ego orientation, perceived competence PLOC scale, intentions	Adaptation of Ryan & Connell's PLOC scale
Briere et al. (1995) Study 1 18.46 yrs	122 M 73 F	Convergent validity of French version of sport motivation scale	Sport	Cross-sectional	Sport motivation scale	French version of Sport Motivation Scale
Chantal et al. (1996) 19.5 yrs	63 M 35 F	Examined elite athletes' levels of self-determination	Competitive sport	Cross-sectional	Sport motivation scale, titles & medals of athletes	Bulgarian version of Pelletier et al.'s (1995) sport motivation scale
Chatzisarantis et al. (1997) 13.5 yrs	21 M 79 F	Relationship between self-determination theory, intentions, & generality of behavioral change	School settings & leisure	Prospective	Intentions, physical activity during leisure time	Mullen et al.'s (1997) behavioral regulation scale
Chatzisarantis & Biddle (1998) 40 yrs	51 M 50 F	Self-determination theory & intention formation	Leisure time	Cross-sectional	Phys. activity, intentions, PLOC for phys. activity attitudes, subjective norms, intentions, perceived control	Adaptation of Ryan & Connell's PLOC scale
Chatzisarantis et al. (2002) 13.5 yrs	78 M 62 F	Prediction of physical activity	Leisure	Prospective	Attitudes, control, effort, past behavior, intentions, & PLOC for phys. activity	Mullen et al.'s (1997) behavioral regulations scale

Georgiadis et al. (2001) 30.8 yrs	*N* = 350	Prediction of global & physical self-worth	Leisure	Cross-sectional	Goal orientations, PLOC, global self-worth & physical self-worth	Greek version of Pelletier et al. ‘s (1995) sport motivation scale
Goudas et al. (1994) 12–14 yrs	39 M 46 F	Looking at phys. activity intentions from a goals & self-determination theory perspective	Physical education	Cross-sectional	Goal orientations, PLOC, perceived competence, intrinsic interest, intention, activity preference	Adaptation of Ryan & Connell’s PLOC scale
Goudas et al. (1995) 20–25 yrs	23 M 17 F	Examination of determinants of intrinsic motivation	Physical education	Prospec-tive	PLOC, perceived compe-tence, intrinsic motivation, intention, performance	Vallerand et al.’s academic motivation scale
Hagger et al. (2002) 12–14 yrs	551 M 537 F	Links between PLOC & theory of planned behavior	Leisure time	Cross-sectional	PLOC for leisure time, & theory of planned behavior	Adaptation of Ryan & Connell’s (1989) PLOC scale
Hamer et al. (2002) 35.8 yrs	147 M 41 F	Prediction of running addiction	Amateur sport	Prospec-tive	PLOC, running addiction scale	Mullan et al.’s (1997) behavioral regulations scale
Li (1999) Study 2 College age	*N* = 371	Develpmnt. & validity of an exercise motivation scale	Leisure time	Cross-sectional	Exercise motivation scale	Exercise motivation scale
Li (1999) Study 3 21.49 yrs	205 M 393 F	Examined hierarchical & simplex structure of the exercise motivation scale	Leisure time	Cross-sectional	Exercise motivation scale, perceptions of exercise competence, exercise auto-nomy, relatedness, exerc. interest, exercise effort	Exercise motivation scale

(*continued*)

Table 1 (*Continued*)

Studies Age of participants	Sample size	Purpose	Context	Design	Measures used	Measures of PLOC
Li & Harmer (1996) 20.93 yrs	442 M 415 F	Examined the simplex structure of Pelletier et al.'s (1995) sport motivation scale across gender	Sport	Cross-sectional	Sport motivation scale	Pelletier et al.'s (1995) sport motivation scale
Mullen & Markland (1997) 37.4 yrs	158 M 157 F	Relationship between PLOC scale for exercise & stages of change	Leisure time	Cross-sectional	PLOC scale for physical activity, stages of change	Mullan et al.'s (1997) behavioral regulations scale
Ntoumanis (2001a) 15.7 yrs	*N* = 253	Relationship between PLOC scale, psychological needs & intentions	Phys Ed & leisure time	Cross-sectional	PLOC, competence, relatedness, autonomy, & intentions	Adaptation of Ryan & Connell's (1989) PLOC scale
Ntoumanis (2001b) 20.4 yrs	*N* = 268	Relationship between goal orientations & PLOC	Sport	Cross-sectional	Goal orientations, PLOC, competence	Pelletier et al.'s (1995) sport motivation scale
Pelletier et al. (1995) Study 1 19.2 yrs	319 M 274 F	Translation of sport motiv. scale from French to Engl. Construct validity of sport motivation scale	Sport	Cross-sectional	Sport motivation scale	Briere et al.'s (1995) French version of sport motivation scale
Standage, Duda, Ntoumanis (2003) 13.56 yrs	*N* = 328	Prediction of physical activity intentions	Phys ed & leisure time	Cross-sectional	Perceived climate in phys educ, comptence, relatedness, autonoomy	Pelletier et al.'s (1995) sport motivation scale

Standage, Treasure, et al. (2003) Study 1 16.13 yrs	*N* = 439	Validity of situational motivation scale	Sport	Cross-sectional	Situational motivation scale	Situational motivation scale
Standage, Treasure, et al. (2003) Study 1 13.2 yrs	182 M 136 F	Validity of situational motivation scale	Physical education	Cross-sectional	Situational motivation scale	Situational motivation scale
Standage, Treasure, et al. (2003) Study 1 20.82 yrs	99 M 122 F	Validity of situational motivation scale	College phys. act. course	Cross-sectional	Situational motivation scale	Situational motivation scale
Standage, Treasure, et al. (2003) Study 2 12–14 yrs	1,008 F	Validity of situational motivation scale	Physical education	Experi-mental	Situational motivation scale	Situational motivation scale
Vallerand & Losier (1994) 15.8 yrs	*N* = 77 gender not reported	Self-determination & sportsmanship	Sport	Prospec-tive	Sportsmanship orientations	Briere et al.'s (1995) French version of sport motivation scale
Wang et al. (2002) 12.71 yrs	427 M 391 F	Goal & motivational profiles in the context of physical education	Phys ed & leisure time	Cross-sectional	PLOC for PE, beliefs re. sports ability, participation in leisure, phys. activity, task & ego orientations, perceived competence	Goudas et al. PLOC for physical education used by Goudas et al. (1994)

Note: None of the longitudinal studies assessed intentions, PLOC constructs, and/or competence longitudinally.

Based on statistical information gathered from the studies, we estimated four parameters: (a) a correlation coefficient corrected for sampling error; (b) a correlation corrected both for sampling error and measurement error; (c) a standard error, which reflects variance of correlations corrected for sampling error (Hunter & Schmidt, 1990); and (d) a standard deviation reflecting variance of correlations, corrected for sampling error and measurement error (Whitener, 1992).

The corrected correlations, standard errors, and standard deviations can be used to calculate both confidence and credibility intervals. Confidence intervals can be constructed by using standard errors around corresponding correlations that are corrected for sampling error (Whitener, 1992). Large standard errors and confidence intervals suggest that the power of the meta-analysis is low, perhaps owing to inclusion of a small number of studies. Standard errors and confidence intervals are therefore estimates of the accuracy of a correlation coefficient. A credibility interval can be constructed by using standard deviations around the correlations corrected for sampling error and measurement error. Credibility intervals indicate the extent to which an association (e.g., a relationship between external regulation and introjection) is consistent across studies. If artifacts account for less than 75% of the uncorrected variance (Hunter et al., 1982), the credibility intervals are considered large and the results across studies are inconsistent. If, by contrast, artifacts account for more than the 75% of the uncorrected variance, the credibility intervals are considered small and the results are consistent across studies.

In the case of large credibility intervals, researchers can use a moderator analysis to investigate whether study characteristics might explain variance in study results. A moderator analysis involves the classification of studies into groups on the basis of some criteria (study characteristics) and then running separate meta-analyses for each group of studies. With regard to applications of PLOC, reasonable classification criteria can be the context that instruments of PLOC are referring to (e.g., sport, physical education, or exercise) or gender (Chantal et al., 1996). Finally, the present meta-analysis examined the adequacy of the models shown in Figures 1 and 2 in terms of how they explain the corrected correlation matrices through path analysis by following Cudeck's (1989) and Tett and Meyer's (1993) recommendations.

Results

Effect Sizes and Consistency of Study Results

Table 2 presents correlation coefficients between dimensions of PLOC, corrected for sampling error and measurement error, as well as standard errors and standard deviations of these correlation coefficients. The magnitude of the correlations suggests the presence of a continuum, given that the correlation coefficients between the adjacent factors (e.g., external regulation and introjection) are greater than those between the factors lying further apart on the hypothesized continuum (e.g., external regulation and identification). The relatively low standard error suggests that, in spite of the small number of studies, the correlations are relatively accurate. The magnitude of standard errors indicates the extent of second-order sampling error (Hunter & Schmidt, 1990). It also supports the power of the present meta-analysis to detect significant relationships between adjacent dimensions of PLOC at the .001 alpha levels. None of the correlations between

adjacent dimensions of PLOC were statistically insignificant. The relatively large standard deviations of the correlation coefficients, however, do indicate the presence of moderating variables.

To examine whether context explains variability in study results, we split the studies in terms of the context that PLOC instruments referred to (education vs. sport vs. leisure physical activity) and performed three meta-analyses for each group of studies. We classified the studies in terms of context on the basis of the PLOC constructs employed, since primary studies used different PLOC constructs depending on the context being examined. In comparison to single-group meta-analysis, the moderator analysis did not reduce the variability in study results, nor did it point out statistically significant differences between correlations after applying Hunter and Schmidt's (1990) *z*-tests that account for second-order sampling error. However, the power of this moderator meta-analysis is low because the predicted Type II error rates are estimated to be .50 at the .05 alpha level (Field, 2001). Given the low power of moderator analysis for detecting differences between correlations at the .05 alpha level, and even less power at the .001 alpha level, the conclusion that context *does not* explain variability in study results must be treated with caution.

The Simplex-Ordered Structure of PLOC

Examination of the hypothesized simplex-ordered structure of correlation coefficients, corrected for sampling and measurement error, was conducted through path analysis. Cudeck (1989) suggested that path analysis could be performed on correlation matrices only if the hypothesized models are not scale-invariant. A model is scale-invariant when it does not constrain parameter estimates at a fixed non-zero value. When a model constrains parameters at some non-zero value, it is not scale-invariant and path analysis on correlation matrices is inappropriate. In the present study, the hypothesized model is scale-invariant because parameters are not fixed at non-zero values. For example, the hypothesized model required path coefficients between the adjacent dimensions of the PLOC to be free, and path coefficients between nonadjacent dimensions to be fixed to zero.

Figure 1a and 1b displays parameter estimates of two models that are hypothesized to explain correlations corrected for sampling error and measurement error. Through the model shown in Figure 1a, we can examine the extent to which a correlation matrix involving only one dimension of intrinsic motivation to experience stimulation is simplex-ordered. The comparative fit index of this model was .98, which satisfies recent criteria for good fit (Hu & Bentler, 1999).

With regard to the model's parameters, amotivation and identification were positively associated with external regulation and intrinsic motivation, respectively. Moreover, path coefficients supported a positive indirect effect of external regulation on identification via introjection (indirect effect = .27). However, the Lagrange Multiplier Test did reveal improvements in model fit if the paths from amotivation to identification and from external regulation to intrinsic motivation were released. Estimation of these paths improved model fit (chi-square change = 170.75 $p < .001$), and negative relationships were found between amotivation and identification (–.24) and between external regulation and intrinsic motivation (–.20). These negative relationships did not reject the hypotheses relating to the simplex-ordered structure of the correlation matrix, however, because the direct

Table 2 Meta-Analytic Estimates of Correlation Coefficients Between Dimensions of PLOC

	No. of studies	Sample size	Correlation coefficients SE	ME	Error estimates *SE*	*SD*
Amotivation / External regulation	10	4198	.41	.53	.06	.24
Amotivation / Introjection	12	4927	.10	.14	.03	.13
Amotivation / Identification	10	4124	–.11	–.15	.07	.29
Amotivation / IM to know	4	1914	–.11	–.14	.05	.10
Amotivation / IM to accomplish	4	1914	–.16	–.20	.06	.13
Amotivation / IM to experience stimulation	8	3996	–.20	–.27	.06	.22
External regulation / Introjection	17	7085	.34	.45	.04	.19
External regulation /Identification	16	6011	.08	.10	.06	.34
External regulation / IM to know	4	1914	.13	.16	.07	.16
External regulation / IM to accomplish	5	2016	.09	.11	.09	.25
External regulation / IM stimulation	18	7745	–.09	–.12	.06	.32
Introjection / Identification	17	6397	.40	.55	.02	.11
Introjection / IM to know	4	1914	.15	.19	.05	.10
Introjection / IM to accomplish	4	1914	.22	.29	.05	.11
Introjection / IM to experience stimulation	17	7156	.31	.39	.03	.15
Identification / IM to know	4	1914	.36	.48	.07	.17
Identification / IM to accomplish	5	2016	.32	.43	.06	.16
Identification / IM to experience stimulation	16	6011	.58	.75	.05	.25
IM to know / IM to accomplish	4	1914	.62	.75	.04	.10
IM to know / IM stimulation	5	2015	.55	.69	.04	.10
IM to accomplish / IM stimulation	5	2016	.62	.79	.08	.21

Note: IM = intrinsic motivation. Correlation coefficient corrected for: sampling error (SE); Sampling error and measurement error (ME). Error estimates are standard errors (*SE*) and standard deviations (*SD*). Underlined correlation coefficients are not significantly different from zero at .001 alpha level.

effects of amotivation to identification, and of external regulation to intrinsic motivation, were smaller than the indirect effects of external regulation to identification. These results therefore support the conclusion that the structure of correlation matrices involving external regulation, introjection, and identification are indeed simplex-ordered, and that this structure is independent from amotivation and intrinsic motivation, as would be predicted by proponents of self-determination theory (Deci & Ryan, 1985; Ryan & Connell, 1989).

We examined the simplex-ordered structure of the correlation matrix, operationalizing intrinsic motivation on three dimensions, by estimating the parameters of the model of Figure 1b. Unlike the model of Figure 1a, the fit of this second model did not exceed recent criteria of good fit; but it did exceed older criteria of good fit, given that the comparative fit index was .92 (Hu & Bentler, 1999). The Lagrange Multiplier Test indicated that the model's fit would improve significantly if three parameters were assumed to be greater than zero (chi-square difference = 129.42, $p < .001$). These parameters were concerned with two paths from amotivation to intrinsic motivation to accomplish, and to identification, as well as with a path from external regulation to intrinsic motivation to experience stimulation.

After these path coefficients were released, path-analytic estimates revealed a positive indirect effect from external regulation to identification (indirect effect = .30). In addition, the paths indicated by the Lagrange Multiplier Test were all negative and their absolute values were smaller than the indirect effect of external regulation on identification. Collectively, these results support the simplex-ordered structure of correlation matrices including external regulation, introjection, and identification. In addition, the strength of the structure is independent of the three-dimensional concept of intrinsic motivation.

Mediating Effects of PLOC

Table 3 presents correlation coefficients, corrected for sampling and measurement error, between PLOC, perceived competence, and intentions, as well as standard errors and deviations of each pairwise correlation coefficient. The relatively low standard errors suggested that, in spite of the small number of studies, correlations were accurate and significantly different from zero at $p < .001$. An exception was the correlation coefficient between external regulation and competence, which was statistically insignificant at the .001 alpha level. With the exception of standard deviations for correlation coefficients between competence and intentions, and between amotivation and competence, all other standard deviations were large.

To examine the mediating effects of PLOC on the relationship between perceived competence and intentions, we conducted a path analysis using correlations, corrected for sampling and measurement error, as an input matrix (Tables 2 and 3). In keeping with the path model of Figure 1, the model of Figure 2 is scale-invariant because none of the parameters were fixed at a non-zero value (Cudeck, 1989). The only parameters that were fixed at a zero value were direct effects of perceived competence on intentions. Finally, residual correlation coefficients between adjacent dimensions of PLOC were estimated because the important antecedent variables of perceived autonomy and relatedness were missing (i.e., the model is incomplete). Therefore the only hypothesis that was tested concerned the mediating effects of PLOC in the perceived competence/intention relationship. Note here that the power of the path model to detect a direct association between competence and intentions is very low, given that the Type II error rates of the correlation between competence and intentions are estimated to be .17 at the .05 alpha level (Field, 2001).

The comparative fit index for the model of Figure 2 was .97, and thus exceeded recent criteria for good fit (Hu & Bentler, 1999). Furthermore, the Lagrange

Table 3 Meta-Analytic Estimates of Correlation Coefficients Between PLOC, Perceived Competence, and Intentions

	No. of studies	Sample size	Correlation coefficients SE	ME	Error estimates *SE*	*SD*
Amotivation / Competence	5	2161	–.27	–.36	.07	.03
External regulation / Competence	7	3784	–.01	–.02	.07	.26
Introjection / Competence	8	4112	.24	.34	.04	.12
Identification / Competence	7	3024	.35	.48	.05	.18
IM to experience stimulation / Competence	7	3784	.48	.62	.06	.20
Amotivation / Intentions	3	724	–.36	–.48	.07	.15
External regulation / Intentions	6	2454	–.15	–.20	.04	.13
Introjection / Intentions	7	2782	.23	.30	.04	.11
Identification / Intentions	6	1695	.39	.50	.06	.17
IM to experience stimulation / Intentions	6	2454	.53	.67	.07	.19
Competence / Intentions	5	1332	.38	.47	.02	.00

Note: Correlation coefficient corrected for: sampling error (SE); Sampling error and measurement error (ME). Error estimates are standard errors (*SE*) and standard deviations (*SD*). Underlined correlation coefficients not significantly different from zero at .001 alpha level.

Multiplier Test did not indicate improvements in model fit if the direct effect of perceived competence to intentions was estimated. With regard to parameters of the model, there were statistically significant indirect effects of perceived competence to intentions via amotivation, intrinsic motivation to experience stimulation, and introjection. The remaining indirect paths were not significant. The total effect of perceived competence on intentions was .51. Therefore, results of the path analysis support the existence of indirect effects of perceived competence on intentions via amotivation, introjection, and intrinsic motivation to experience stimulation, but not via external regulation and identification.

Discussion

The Self-Determination Continuum

The meta-analysis of correlations between dimensions of PLOC support two conclusions pertinent to the self-determination continuum in sport and exercise. The models presented in Figure 1a and 1b support the conclusion that the pattern of correlations between external regulation, introjection, and identification conform to a simplex-ordered structure. However, a correlation matrix including mea-

sures of intrinsic motivation (unidimensional and three-dimensional intrinsic motivation) and amotivation is not, strictly speaking, a simplex-ordered matrix because the Lagrange Multiplier Test points out linear dependencies between nonadjacent dimensions. Furthermore, estimation of nonhypothesized paths of amotivation and intrinsic motivation, suggested by the Lagrange Multiplier Test, did not attenuate the hypothesized indirect effects of external regulation to identification via introjection. These results therefore support the assumptions of self-determination theory concerning the independence of internalization and intrinsically motivated processes.

More specifically, it has been suggested that intrinsic motivation, amotivation, and internalization are different processes (Deci et al., 1999a; Ryan & Deci, 2000). Intrinsic motivation occurs when interest is the main factor that motivates behavior. In contrast, internalization explains how individuals become motivated to engage in an initially boring activity (Deci et al., 1994). During internalization, experiences of enjoyment and interest are still important (Deci & Ryan, 1990); however, internalization is expected to be phenomenologically aversive, at least during the initial stages of interaction with the behavior. In the present meta-analysis, the unpleasant nature of internalization processes is supported by the mediating effects of introjection on the relationship between external regulation and identification that were not attenuated by amotivation and measures of intrinsic motivation.

A second conclusion regarding the validity of the self-determination continuum is concerned with variability of study results. Results of primary studies appear to be variable because none of the standard deviations of correlations between dimensions of PLOC were small (Standage, Duda, & Ntoumanis, 2003). Variability of results from primary studies cannot be attributed to context or type of PLOC measure, given that moderator analysis did not reveal any significant results. However, the Type II error rates of this moderator analysis should be inflated because of the relatively small number of studies. Ideally, a moderator meta-analysis of a larger set of studies will permit a statistically powerful moderator analysis, using context (physical education, sport, physical activity), gender, and/or age.

An important variable that might have contributed to variable results across studies is concerned with study design. Few of the studies using PLOC were experimental (Standage, Treasure, Duda, & Prusak, 2003). Most of the designs were cross-sectional or prospective and used self-report measures. Moreover, prospective studies were aimed at the prediction of repeated measures of behavior and did not assess dimensions of PLOC and intentions repeatedly. From the perspective of self-determination theory, the continuum is assumed to be a "developmental continuum," meaning that with time comes a progressive change of various internalization processes (Ryan & Deci., 2000). According to Li (1999), a developmental continuum can be confirmed through panel designs, and by assessing individuals over time while assessing PLOC at least twice (Hertzog & Nesselroade, 1987). Such designs provide more accurate tests of a *developmental* self-determination continuum and, consequently, may help deduce accurate inferences about the self-determination continuum. For this reason, the present conclusions about the process of internalization should be treated as tentative because of the cross-sectional design of the studies.

On the Antecedents and Consequences of PLOC

In addition to examining the structure of correlations between dimensions of PLOC, the meta-analysis was used to examine associations of PLOC with antecedent and outcome variables. Similar to correlations between dimensions of PLOC, the meta-analysis of correlations between PLOC with perceived competence and intentions revealed accurate but inconsistent results across studies. Such inconsistency alerts researchers on the existence of possible moderator variables. Accuracy of correlations, however, supports the power of the meta-analysis to detect statistically significant relationships.

Path analysis, using the correlation matrix corrected for sampling and measurement error (see Table 3) as input matrix, supported the mediating effects of PLOC on the relationships between perceived competence and intentions. Mediating effects of PLOC provide strong support of Vallerand's (1997) hierarchical model of intrinsic and extrinsic motivation. More specifically, Vallerand found that at a contextual level of analysis such as a school setting, perceived self-determination mediated effects of sport competence on intentions. However, that study used a composite score, collapsing across dimensions of PLOC.

The present meta-analysis replicates the findings reported by Vallerand, in addition to having used all the dimensions of PLOC. This analysis allows us to conclude that the effects of perceived competence on intentions vary as a function of PLOC. According to Deci and Ryan (1985), effects of perceived competence on intrinsic motivation (and hence on intentions) can be expected when a controlling aspect or informational aspect of internal events (such as competence) is salient to the individuals. The present study confirms this proposition in the context of sport, education, and leisure physical activity by showing that perceived competence influences intentions via intrinsic motivation to experience stimulation, introjection, and amotivation (Ntoumanis, 2001a; Ryan, Koestner, & Deci, 1992).

Although relationships between perceived competence and dimensions of PLOC are in line with theoretical predictions of self-determination theory, the relationship between introjection and intentions is less well explained. In general, most of the studies used Ajzen and Fishbein's (1980) theoretical and operational definition of intentions, which assumes that intentions represent volitional decisions. However, the unique effect of introjection on intentions indicates that the latter may not always represent volitional decisions, given that introjection represents behavior that is endorsed with a sense of compulsion. Therefore a final, but tentative, conclusion that can be drawn from the results of the present meta-analysis is that intentions confound volitional and forced decisions.

As a result, it can be argued that theories which represent volitional processes through unidimensional measures of intentions contain an element of indeterminacy because unidimensional intentions confound volitional and forced decisions. For this reason it may be appropriate to use alternative measures of intentions, such as integrated intentions (Chatzisarantis, Biddle, & Meek, 1997), which differentiate between volitional and forced decisions. Furthermore, it can be suggested that measures of integrated intentions and PLOC may differ. Integrated intentions indicate the degree to which a decision to engage in *prospective* action is volitional. In contrast, the PLOC leaves time unspecified as it measures one's usual motivation in leisure time.

Conclusions

Results of the present meta-analysis support the existence of a self-determination continuum from external regulation to identification via introjection. Also, the self-determination continuum appears to be independent from amotivation and intrinsic motivation. Thus it can be concluded that internalization, intrinsic motivation, and amotivation constitute qualitatively distinct processes. Moreover, results from the path analysis show that introjection and intrinsic motivation mediate the effects of perceived competence on physical activity. Hence physical competence is a necessary but not sufficient condition for developing strong intentions and an internal PLOC, given that perceived competence can induce introjections.

As for the apparent inconsistency of results, relationships between dimensions of PLOC and between PLOC and perceived competence and intentions vary greatly, even after accounting for differences in sample size and reliability between studies. Variation in study results is an indicator of possible moderator variables that the present meta-analysis might not have been powerful enough to detect, due to the small number of studies available. However, the power of the present meta-analysis is sufficient to detect statistical significance of hypothesized relationships that are greater than .30 at the .05 alpha level. Hence the failure to explain variability in study results is due to small differences that may represent the influence of context on relationships between dimensions of PLOC. Therefore, given the high power and low Type I error rates, which have been controlled by reducing the alpha level to .001, the results of the present meta-analysis allow confidence in the aforementioned conclusions.

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Manuscript submitted: October 9, 2001
Revision accepted: March 25, 2003