

Running head: SELF-DETERMINATION THEORY AND EXERCISE

Testing a self-determination theory based teaching style in the exercise domain

Jemma Edmunds, Nikos Ntoumanis, Joan L. Duda
The University of Birmingham, United Kingdom

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Author Note:

Jemma Edmunds is now at the Health Services Research Centre, School of Health and Social Science, Coventry University

Address for correspondence:

Jemma Edmunds
Health Services Research Centre
School of Health and Social Science
Coventry University
Priory Street
Coventry
CV1 5FB
United Kingdom
Tel: +44(0)2476888334
Fax: +44(0)2476887079

E-mail: J.Edmunds@coventry.ac.uk

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1 Abstract

2 This study examined the effect of a self-determination theory-based (i.e., autonomy
3 supportive, well structured and interpersonally involved), versus realistically controlling,
4 teaching style on exercise class participants psychological need satisfaction, motivational
5 regulations, exercise behavior (general and specific), class commitment, behavioral intention
6 to continue participating, enjoyment and affect. Moreover, the demographic and SDT-based
7 constructs predicting each of the aforementioned variables were explored. Female exercise
8 class participants enrolled in a 10-week exercise program were exposed to a SDT-based (i.e.,
9 SDTc; $n = 25$) or realistically controlling (i.e., RCc; $n = 31$) teaching style. Compared to the
10 RCc, the SDTc reported a significant linear increase in structure and interpersonal
11 involvement, relatedness and competence need satisfaction, positive affect and class
12 enjoyment. Attendance rates were significantly higher in the SDTc. SDT-based social-
13 contextual characteristics and psychological needs predicted autonomous regulation, which,
14 collectively, predicted adaptive outcomes. This study offers experimental support for SDT in
15 the exercise domain.

16

17 *Key words:* Autonomy support, structure, interpersonal involvement, psychological need
18 satisfaction, motivational regulations, exercise class.

19 .

1 SDT also proposes three broad categories of motivation, namely: (a), amotivation, (b),
2 extrinsic motivation, which is itself made up of four different types of regulation, namely
3 external, introjected, identified and integrated regulations, and (c), intrinsic motivation. Each
4 type of motivation is believed to vary with regard to the amount of autonomy associated with
5 it, and thus, to lie along a continuum ranging from low to high self-determination (Deci &
6 Ryan 1985, 1990).

7 *Amotivation* reflects non-self-determined motivational striving, and represents “a
8 state lacking of any intention to engage in a given behavior” (Deci & Ryan, 1985; Markland
9 & Tobin, 2004a). With *external regulation*, the least autonomous form of extrinsic
10 motivation, an individual engages in an activity to obtain external rewards or to avoid
11 punishments (Deci & Ryan, 1985). *Introjection* reflects a partial internalization of a
12 behavior’s regulation. That is, although the regulation of the activity lies within the
13 individual, the person does not fully accept the behavior as his/her own (Ryan & Deci, 2000).
14 Thus, individuals guided by introjected regulation engage in the activity with a sense of
15 pressure and stress, because their self-worth is dependent upon it, or to attain ego
16 enhancement (Ryan & Deci, 2000). *Identified regulation* reflects participation in an activity
17 because one holds certain outcomes of the behavior to be personally significant (e.g.,
18 improved health), whereas *integrated regulation*, the most autonomous form of extrinsic
19 motivation, occurs when identified regulations are fully assimilated into the self and are
20 brought into congruence with one’s other values and needs (Deci & Ryan, 2000). Finally,
21 *intrinsic motivation* involves partaking in an activity for its own sake (Deci, 1975; Deci &
22 Ryan 2000), because the activity is inherently enjoyable.

23 SDT posits that intrinsic motivation and the most internalized/autonomous forms of
24 extrinsic motivation (i.e., integrated and identified regulation) will guide behavior when the
25 three basic psychological needs are satisfied. When the needs are thwarted however, more

1 controlling motivations (i.e., introjected and external regulations and amotivation) are
2 expected to guide behavior (Deci & Ryan, 1985). Furthermore, SDT postulates that
3 satisfaction of the psychological needs will directly, and indirectly via the more autonomous
4 forms of motivational regulation they elicit, lead to adaptive behavioral, cognitive and
5 affective responses (Deci & Ryan, 1985; Vallerand, 1997). In contrast, a thwarting of the
6 needs and more controlling forms of regulation are proposed to result in a variety of non-
7 optimal outcomes (Ryan & Deci, 2000).

8 *Facilitating psychological need satisfaction, autonomous motivation and adaptive outcomes*

9 Autonomy support is proposed as being central to the promotion of psychological
10 need satisfaction, autonomous regulation and adaptive outcomes (Deci & Ryan, 1985).

11 Autonomy support involves an individual in a position of authority taking the perspective of
12 others' into account, acknowledging their feelings, providing them with pertinent
13 information, opportunities for choice and a meaningful rationale, whilst minimizing the use
14 of pressure and demands (Black & Deci, 2000).

15 Supporting the propositions of SDT in the educational domain, perceived autonomy
16 support has been shown to exert a significant influence on students' perceptions of autonomy
17 and competence (Hamm & Reeve, 2002). Similarly, in the health care domain, autonomy
18 support has been shown promote perceptions of autonomy and competence for diabetes
19 management (Williams, McGregor, Zeldman, Freedman & Deci, 2004), as well as
20 autonomous motivation for weight loss (Williams, Grow, Freedman, Ryan, & Deci, 1996)
21 and medication adherence (Kennedy, Goggin, & Nollen, 2004; Williams, Rodin, Ryan,
22 Grolnick & Deci, 1998). When compared to a controlling interpersonal style, experimental
23 research has also revealed that the adoption of an autonomy supportive interpersonal
24 counseling style, utilized to help patients stop smoking, predicts autonomous motivation,

1 which, in turn, results in greater abstinence at 6-, 12-, and 30-months post quit date
2 (Williams, Gagne, Ryan & Deci, 2002).

3 Structure and interpersonal involvement have also been proposed to be fundamental
4 to psychological need satisfaction and subsequent motivational processes and actions
5 (Koestner & Losier, 2002; Reeve, 2002). Structure refers to the extent to which socializing
6 agents provide consistent guidelines and rules for behavior (Reeve, 2002). Structure involves
7 giving clear expectations, providing optimal challenge, and offering timely and informative
8 feedback; all of which should be delivered in an autonomy supportive manner (Reeve, 2002,
9 2004). Interpersonal involvement refers to the quality of the relationship between those in a
10 position of authority (e.g., a teacher) and the individuals they interact with, and represents the
11 formers' willingness to dedicate psychological resources, such as time, energy, and affection
12 (Reeve, 2002).

13 SDT also holds that controlling teachers thwart psychological need satisfaction, by
14 taking little account of the perspective of others, pressuring them to behave in a particular
15 way, and providing feedback in a critical and demeaning manner (Black & Deci, 2000;
16 Williams & Deci, 1998). As a result, more controlling forms of motivational regulation and
17 less adaptive outcomes are expected among the student(s).

18 *Evidence supporting the propositions of SDT in the exercise domain*

19 A growing body of research evidence has recently emerged which provides
20 preliminary support for the basic theoretical propositions of SDT in the exercise domain.
21 Perceived autonomy support from an exercise instructor (Edmunds, Ntoumanis & Duda, in
22 press) and friends (Wilson & Rodgers, 2004) has been shown to be positively related to
23 psychological need satisfaction and more autonomous forms of motivational regulation. In
24 addition, exercise-specific psychological need satisfaction has been shown to be positively
25 associated with the autonomous regulation of exercise behavior (Edmunds et al, in press;

1 Wilson, Rodgers, Blanchard & Gessell, 2003; Wilson, Rodgers & Fraser, 2002). Moreover,
2 psychological need satisfaction and the more self-determined forms of motivational
3 regulation have been corresponded to more adaptive exercise behavior (Edmunds et al., in
4 press; Wilson et al., 2002, 2003), greater physical fitness (Wilson et al., 2003), positive
5 attitudes towards exercise (Wilson et al., 2003), and important cognitive and affective
6 outcomes (Edmunds, Duda, & Ntoumanis, 2005).

7 However, the majority of research supporting the utility of SDT's propositions in the
8 exercise domain, to date, has been cross-sectional in design. One study that has provided
9 experimental support for the utility of SDT in the physical domain is that of Vansteenkiste,
10 Simons, Soenens, and Lens, (2005). Vansteenkiste and colleagues (2005) used a randomized
11 4 x 2 experimental design to examine the effect of intrinsic versus extrinsic exercise goals on
12 motivation to engage in exercise, and resultant behavioral outcomes, among a sample of 10th
13 - 12th grade students. In addition, they considered the benefits of presenting exercise goals in
14 an autonomy supportive, versus controlling, manner. Results revealed that intrinsic goal
15 framing lead to adaptive motivational and behavioral outcomes, whereas extrinsic exercise
16 goals undermined advantageous responses. In addition, goals presented in an autonomy
17 supportive manner were observed to result in the same motivational and behavioral benefits
18 as future intrinsic goal framing.

19 Although the Vansteenkiste et al, (2005) study supports SDT's propositions, this work
20 was conducted in a physical education setting. It is still not known whether the propositions
21 of SDT can be utilized to promote engagement among adult exercisers in a fitness context.
22 Furthermore, Vansteenkiste et al, (2005) required participants to read the studies
23 manipulations, and thus, did not explore the advantages associated with manipulating an
24 instructor's/teacher's interpersonal style so that exercise is taught in accordance with social-
25 contextual characteristics advanced by SDT. Although previous experimental studies in the

1 physical domain have acknowledged the importance of social and structural contextual
2 characteristics, as provided by an exercise instructor, on behavioral and affective responses to
3 exercise (e.g., Bray, Millen, Eidsness & Leuzinger, 2004), no studies have yet to examine the
4 benefits associated with an exercise instructor delivering an exercise class in line with the
5 theoretical tenets of SDT.

6 *Aims and hypotheses*

7 The main aim of the current study was to experimentally test the propositions of SDT
8 in the exercise class setting. Pulling from the social-contextual characteristics proposed by
9 SDT, this research compared the effects of an autonomy supportive, well-structured and
10 interpersonally involved (i.e., SDT-focused condition; SDTc), versus realistically controlling
11 (i.e., realistically controlling condition; RCc), teaching style on exercise class participant's
12 psychological need satisfaction, motivational regulations, and behavioral (i.e., class
13 attendance and total self-reported exercise behaviors), cognitive (i.e., commitment to the
14 class and behavioral intention to continue participating), and affective (i.e., class enjoyment
15 and positive and negative affect) responses to a 10-week exercise class program.

16 In doing so, the first task of the present study was to examine whether an exercise
17 instructor's teaching style can be manipulated so that it is perceived by exercise class
18 participants, and independent observers, as providing more autonomy support, structure and
19 interpersonal involvement. Given that autonomy support has been defined as a mode of
20 communication that is context free, and that a number of studies in the educational and health
21 care domains have shown that teachers/practitioners can be taught how to be autonomy
22 supportive (e.g., Reeve, 1998; Reeve, Jang, Carrell, Jeon, & Barch, 2004; Williams, et al,
23 2002), we felt that it should be possible to modify this aspect of the exercise instructor's
24 teaching style. Similarly, it is also possible to envisage how structure and interpersonal
25 involvement can be operationalized in an exercise class setting. For example, setting goals at

1 the start of an exercise class would be one strategy to foster perceptions of structure.
2 Moreover, interacting with and getting to know participants before the start of the class
3 should increase interpersonal involvement. Thus, it was hypothesized that the SDTc would be
4 rated by exercise class participants, and independent observers, as providing higher levels of
5 autonomy support, structure and interpersonal involvement, compared to the RCc.

6 Considering past research in the educational and health care domains (e.g., Hamm &
7 Reeve, 2002; Kennedy et al, 2004; Williams et al, 1996; Williams et al, 2004; Williams et
8 al.,1998), and evidence supporting a link between autonomy support, psychological need
9 satisfaction and intrinsic motivation in exercise settings (Edmunds et al., in press), it was also
10 hypothesized that, compared to participants in the RCc, those in the SDTc would report
11 greater increases in reported levels of psychological need satisfaction and autonomous
12 motivation over time. As psychological need satisfaction and autonomous regulation are held
13 to promote adaptive outcomes (Deci & Ryan, 1985), it was also expected that the SDTc
14 would facilitate greater increases in behavioral engagement and improved cognitive and
15 affective responses to the exercise program, compared to the RCc.

16 The final aim of the current study was to examine the mechanisms that explain
17 psychological need satisfaction, motivational regulations and behavioral, cognitive and
18 affective investment in exercise. Aligned with SDT's theoretical framework, and previous
19 experimental research (e.g., Williams et al., 2002), it was hypothesized that autonomy
20 support, structure and interpersonal involvement would predict psychological need
21 satisfaction. In conjunction with the social-contextual characteristics, psychological need
22 satisfaction was hypothesized to predict autonomous regulation. In contrast, a thwarting of
23 the social-contextual conditions and psychological needs was proposed to result in more
24 controlling forms of regulation. Finally, psychological need satisfaction and autonomous
25 regulations were hypothesized to correspond to positive adaptive behavioral, cognitive and

1 affective outcomes. Controlling regulations were expected to result in less desirable
2 consequences.

3 Method

4 *Participants*

5 This study was approved by the ethics subcommittee of a large University in the West
6 Midlands, UK. Participants were female students and staff of the same University, who had
7 signed up for one of two exercise classes run in the University sports center. Participants
8 chose which class they participated in, one class was designated as the SDTc, whilst the other
9 formed the RCc.

10 Twenty five females made up the SDTc. Participants ranged from 18 – 53 years of
11 age ($M = 21.26$, $SD = 3.80$). The RCc included 31 females, who ranged in age from 18 – 38
12 years ($M = 21.36$, $SD = 6.71$). The two groups did not significantly differ in age ($t(54) = .07$,
13 $p = .94$). The majority of participants in the SDTc classified themselves as White (96%; 4%
14 as Chinese). In the RCc, 74% of participants classified themselves as White, 19.3% as
15 Asian/Asian British (i.e., Indian, Pakistani, Bangladeshi, or any other Asian background) and
16 6.5% as Chinese. Chi square analysis, based upon Fisher's exact probability test (utilized
17 because 50% of cells had expected cell counts less than 5), revealed a significant difference
18 ($p = .03$) between the groups in terms of their ethnic composition (i.e., white versus non-
19 white). Ninety six percent of participants in the SDTc, and 90% in the RCc, were University
20 students.

21 *Procedures*

22 Two intermediate level "cardio combo" (i.e., a mix of boxing choreography and step
23 aerobics) classes constituted the mode of exercise in the current study. Classes were held on a
24 Monday (SDTc) and Wednesday (RCc) evening, once a week, for 10 weeks. They were run
25 by the same exercise instructor (i.e., a 28 year old White Canadian female, certified by the

1 Canadian Association of Fitness Professionals, with 11 years of teaching experience), in the
2 same venue, throughout the same academic term (i.e., October – December), and at a similar
3 time of the day (i.e., both classes were held in the early evening). Thus, we attempted to
4 control for the personal characteristics of the exercise class leader, the class characteristics,
5 and possible time of day fluctuations in attendance.

6 The first week's class constituted a 'taster' session, whereby individuals could try out
7 the exercise class before signing up and paying for the duration of the term. The social-
8 contextual characteristics were not manipulated; the instructor used her normal teaching
9 behavior. At the end of this first session, the principle investigator informed participants that
10 their class had been selected to take part in a study being conducted at the University. Upon
11 stressing that participation was voluntary, participants were informed that the study aimed to
12 examine personal and psychological characteristics of the exerciser and exercise class leader
13 which can influence the exercise experience. Participants were not informed that the
14 leadership style exhibited in their class was to be manipulated, nor were they told that they
15 would be compared to another class/condition. To act as an incentive, class members were
16 informed that if they agreed to participate and provided all required data, they would be
17 entered into a £50 (approximately \$90 US) prize draw.

18 Those participants that decided to sign up to the class for the duration of the term, and
19 who were willing to take part in the study, provided informed consent. They also completed
20 an initial questionnaire packet measuring basic demographic variables, perceived autonomy
21 support, structure and interpersonal involvement provided by the exercise instructor,
22 psychological need satisfaction, motivational regulations, general self-reported exercise
23 behavior, commitment, behavioral intention, enjoyment and positive and negative affect. In
24 addition, two independent observers, blind to the experimental conditions, rated the level of
25 autonomy support, structure and interpersonal involvement provided by the exercise

1 instructor in week 1. Moreover, the independent observers also rated the ‘active engagement’
2 (i.e., behavioral intensity and emotional quality of participants’ active involvement in the
3 class; Reeve et al., 2004) demonstrated by participants in each condition.

4 From week 2 to the end of the study (i.e., week 10) the exercise class leader
5 manipulated her behavior to fit the regulatory style selected for that group. In creating the
6 SDTc, the exercise instructor focused upon taking the perspective of the exercise class
7 participants into account, acknowledging their feelings, and providing them with pertinent
8 information and opportunities for choice (Deci, Eghrari, Patrick & Leone, 1994). The use of
9 pressure, demands and extrinsic rewards were minimized (Black & Deci, 2000; Reeve et al.,
10 2004). Clear expectations, optimal challenge and timely and informative feedback were
11 provided (Reeve, 2002; Reeve et al, 2004). The exercise instructor also dedicated
12 psychological resources to the participants, showing that she was interested in them, and was
13 concerned about their well-being (Reeve, 2002; Reeve et al, 2004). Practical examples
14 detailing how the SDTc was created, which pull predominantly from the work of Reeve et al.
15 (2004), are provided in Table 1.

16 The RCc was intended to replicate the style of teaching regularly observed in the
17 exercise setting, whereby exercise instructors seek to maintain control over large groups of
18 individuals, in order to ensure that they are all exercising safely and effectively. However, the
19 RCc was not intended to be detrimental to participants in any way. Although autonomy
20 support, structure and interpersonal involvement were kept to a minimum in the RCc, no
21 attempts were made to purposefully deter/upset participants engaging in this condition.
22 Practical examples detailing how the RCc was created are provided in Table 2.

23 As detailed previously, participants in SDTc condition were given choice regarding
24 what exercises they wanted to do, whereas those in the RCc were not. The first exercise
25 session to be run each week was that of the SDTc, and thus, the exercise class leader

1 replicated those exercises chosen by the SDTc participants in the subsequent RCc.
2 Consequently, we were able to ensure that members of the two classes received comparable
3 physical work-outs, and reduce the likelihood that class differences in outcome variables
4 could be attributed to differences in the physical requirements/demands between the classes.

5 The same measures of autonomy support, structure and interpersonal involvement as
6 those completed during week 1, were rated by participants at weeks 5 and 9. In addition,
7 during weeks 4 and 8, the same independent observers as those utilized in week 1 rated the
8 autonomy support, structure and interpersonal involvement provided by the exercise class
9 leader and the amount of “active engagement” displayed by the exercise class participants
10 (Reeve et al., 2004). This tested the extent to which the desired social-contextual
11 characteristics were effectively manipulated in the SDTc, versus, RCc. Further, at weeks 6
12 and 10, the same measures of psychological need satisfaction, motivational regulations,
13 exercise behavior, commitment, behavioral intention, enjoyment and well-being, as those
14 provided during week 1, were completed by participants.

15 When all measures had been collected, participants were debriefed about the purposes
16 of the study and their questions answered. We recognized that it was possible for participants
17 in the two conditions to have known one another, and that they could have discussed their
18 participation or guessed the nature of the study. Thus, the principle investigator also asked
19 participants whether they had discussed their study involvement with participants of other
20 exercise classes or guessed actual purpose of the study. No participants reported doing so.

21 *Measures*

22 *Socio-environmental characteristics.* The exercise class participants’ perceived
23 provision of autonomy support, structure and interpersonal involvement, as provided by the
24 exercise class instructor, was assessed using the Perceived Environmental Supportiveness
25 Scale developed by Markland and Tobin (2004b). Following the stem “In this exercise class,”

1 three items tap autonomy support, four tap structure, and five tap interpersonal involvement.
2 Previous research has shown these subscales to be internally reliable (Cronbach alpha values
3 of .79, .79 and .78 respectively; Markland & Tobin, 2004b). In addition, an observation rating
4 scale developed by Reeve et al. (2004) was completed by independent observers to measure
5 autonomy support (for items), structure (for items) and interpersonal involvement (for items)
6 provided by the exercise instructor, and the active engagement (five items) displayed by
7 exercise class participants. Previous studies have shown these sub-scales to possess adequate
8 reliability (i.e., α 's $>.81$; Reeve et al., 2004).

9 *Psychological Need Satisfaction.* Psychological need satisfaction was measured via
10 the Psychological Need Satisfaction Scale (Markland and Tobin; 2004b). Following the stem
11 "Considering the class in which you have just exercised", three items tap autonomy, three tap
12 relatedness, and three tap competence. Previous research has revealed Cronbach alpha values
13 of .59, .72 and .69, respectively, for these subscales (Markland & Tobin, 2004b).

14 *Motivational regulations for exercise.* Participants' motivations to engage in the
15 exercise class were measured using the Behavioral Regulation in Exercise Questionnaire-2
16 (BREQ-2; Markland & Tobin, 2004a). Following the stem "Why do you exercise?," separate
17 subscales tap amotivation (four items), external (four items), introjected (three items) and
18 identified (four items) regulations, as well as intrinsic motivation (four items). Cronbach
19 alphas for all BREQ-2 subscales have been shown to exceed .75 (Wilson & Rodgers, 2004).
20 As the BREQ-2 does not contain a measure of integrated regulation, the present study also
21 utilized the integrated regulation subscale (four items) of Li's (1999) Exercise Motivation
22 Scale. This subscale has also been shown to display adequate internal reliability (i.e., α 's
23 $>.75$; Li, 1999).

24 *Exercise Behavior.* Both specific and general measures of exercise behavior were
25 used to determine whether the effect of the SDT-focused instructional style impacted upon

1 investment in the class *per se*, and whether the effects of the intervention also translated into
2 increased physical activity engagement at a wider, global, level. To measure adherence to the
3 exercise class a register of attendance was completed by the exercise instructor each week,
4 for each condition. To measure general physical activity, participants completed the Godin
5 Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shepard, 1985). The GLTEQ
6 contains 3 questions assessing the frequency of mild, moderate and strenuous exercise
7 engaged in, for a minimum of 15 minutes, during a typical week. An overall exercise
8 behavior score (units of metabolic equivalence) is calculated by summing the weighted
9 product of each question as follows: (mild x 3) + (moderate x 5) + (strenuous x 9). Using
10 objective indicators of exercise and physical fitness, previous studies have concluded that the
11 GLTEQ is a reliable and valid measure of leisure time exercise behavior (e.g., Jacobs,
12 Ainsworth, Hartman & Leon, 1993).

13 *Behavioral Intention.* Behavioral intention to continuing exercising in the class was
14 assessed based upon a methodology reported by Wilson and Rodgers (2004). Specifically
15 considering the exercise class in which they had just partaken, participants were asked to
16 respond to three items which reflected both general and specific exercise intentions. At the
17 final assessment, which was at the end of the 10-week course, items were worded to tap
18 whether participants intended to join exercise classes run by their present exercise class
19 leader during the following semester. Previous studies have reported an internal consistency
20 of .89 for this scale (Wilson & Rodgers, 2004).

21 *Commitment.* Commitment to the exercise class was measured via the 4-item
22 commitment sub-scale of the Athletes' Opinion Survey (Scanlan, Carpenter, Schmidt,
23 Simons and Keeler, 1993). Items followed the stem "Considering the exercise class in which
24 you have just taken part, please rate the extent to which the following 4 items apply to you".
25 Each item was amended slightly to make it relevant to the exercise class domain. Previous

1 research has shown the scale to possess adequate internal consistency (i.e., $\alpha = .85$; Scanlan
2 et al., 1993).

3 *Enjoyment.* Enjoyment of the class was assessed using the 4-item interest/enjoyment
4 scale developed by Markland and Tobin (2004b). Following the stem “Considering the class
5 in which you have just taken part” four items measure enjoyment. Previous studies have
6 shown that factor loadings for each item were significant at the $p < .001$ level (Markland &
7 Tobin, 2004b).

8 *Positive and negative affect.* The Positive Affect and Negative Affect Scale (PANAS;
9 Watson, Tellegen & Clark, 1988) was used to measure the positive and negative affect that
10 exercise class participants felt while exercising in the class. This measure consists of 10 that
11 items that tap positive affect and 10 items that tap negative affect. Previous studies have
12 shown the scale to possess acceptable internal consistencies (i.e., α 's ranged from .86 to .90),
13 good test-retest reliability, and factorial and convergent validity (Watson et al., 1988).

14 Results

15 *Reliability analyses and descriptive statistics*

16 Internal consistency estimates (Cronbach alpha's) and descriptive statistics were
17 computed for all variables at each measurement point (see Tables 3 and 4). In general, the
18 observed internal consistency coefficients were greater than .70, although in some cases they
19 were marginal.

20 *Multilevel regression analyses*

21 Following the procedures and guidelines outlined by Singer and Willet (2003),
22 multilevel regression analyses (MLA) using MLwin (version 2.0), was employed to test the
23 main study hypotheses. MLA was chosen as it is particularly useful for the analysis of
24 longitudinal data, where there are several measurements nested within individuals. Our data
25 set was comprised of three weekly observations (weeks 1, 5 and 9 for the ratings of autonomy

1 support, structure and interpersonal involvement, and weeks 1, 6 and 10 for all other study
2 variables), nested within study participants.

3 *Model testing*

4 A series of models addressed the main aims of the current study (i.e., models a – c,
5 described below, were tested for each environmental characteristic and models a – d,
6 described below, were tested for each of the psychological needs, motivational regulations,
7 and behavioral, cognitive and affective outcomes). Model a is an unconditional growth
8 model, where the intercept and rate of change are modeled, for each variable, for the sample
9 as a whole, and predictor variables are not present at any level. Models b – d represent
10 conditional growth models. Conditional growth models examine the intercept and rates of
11 change, for each study variable, when the effects of predictor variables are included in the
12 regression equation. For each model, the intercept reflects the baseline level of the study
13 variable under examination¹, whereas the growth trajectory represents the rate of change
14 (increase, decrease or no change) over the course of the 10-week program. Specifically,
15 model b, represents a series of conditional models estimating the effects of teaching style
16 (i.e., condition, where $RC_c = 0$ and $SDT_c = 1$) on the intercept and growth trajectory, for
17 each variable. Model c represents a series of conditional models estimating the main effects
18 of key demographic variables (i.e., age and ethnicity) on each variable [included as they have
19 been observed to impact exercise behavior in previous SDT-focused exercise studies (i.e.,
20 age; Edmunds et al, in press) or were observed to vary across groups (i.e., ethnicity)]. Finally,
21 model d represents a series of conditional models estimating the main effects of key
22 psychological predictors proposed by SDT to support each need, regulation and outcome.
23 Model d also examines whether the effects of these variables vary over time. Even if found to
24 be non-significant in model b, we retained the effect of condition in models c and d, as this

1 constitutes the key variable of interest in the current study. Thus, we felt it important to
2 control for its effects.

3 *Unconditional growth models*

4 The unconditional growth models (model a) showed that, for the sample as a whole,
5 the levels of all study variables were significantly different from zero at baseline. This is the
6 case for all models reported herein. Examining the trajectories of the unconditional growth
7 models, for the sample as a whole, revealed a significant linear increase over time in
8 interpersonal involvement ($B = 0.32, p < .05$), relatedness need satisfaction ($B = 0.37, p < .01$),
9 competence need satisfaction ($B = 0.67, p < .001$), identified regulation ($B = 0.11, p < .05$) and
10 introjected regulation ($B = 0.20, p < .01$). In contrast, amotivation ($B = -0.16, p < .001$),
11 behavioral intention ($B = -0.54, p < .001$) and commitment ($B = -0.18, p < .01$) demonstrated
12 a significant linear decrease over the course of the 10-week exercise program.

13 *Conditional growth models: Environmental variables*

14 An examination of differences in participants' perceptions of each of the social-
15 contextual characteristics as a function of the two different teaching styles (i.e., model b,
16 Table 5) demonstrated that the SDTc did not differ to the RCc in baseline levels of autonomy
17 support, structure, and interpersonal involvement. Examining the growth trajectories for each
18 of the three social-contextual characteristics revealed that in the RCc, autonomy support
19 demonstrated a significant linear decrease over time. In contrast, the SDTc differed
20 significantly to the RCc in autonomy support, structure, and interpersonal involvement,
21 demonstrating a significant linear increase over time for all three social contextual
22 characteristics.

23 Next ethnicity (0 = White; 1 = Asian/Asian British or Chinese) and age were entered
24 simultaneously as predictors of each of the social-contextual characteristics (i.e., model c).
25 Controlling for condition, ethnicity and gender did not play a role in predicting any of the

1 social contextual characteristics advanced by SDT. Moreover, ethnicity and gender did not
2 play a significant role in any of the models presented subsequently, and thus, model c shall
3 not be discussed further.

4 *Conditional growth models: Psychological needs*

5 Examining differences in each of the psychological needs by condition (i.e., model b),
6 the intercepts for autonomy, relatedness, and competence need satisfaction for participants in
7 the SDTc were not significantly different to those in the RCc. In the RCc, competence need
8 satisfaction was the only psychological need to demonstrate a significant change over time (B
9 = 0.32, $p < .05$). Compared to the participants in the RCc, participants in the SDTc displayed a
10 significantly greater linear increase in relatedness ($B = 0.50$, $p < .05$) and competence ($B =$
11 0.66 , $p < .01$) need satisfaction.

12 In an attempt to understand the particular aspects of the instructor's regulatory style
13 that predicted psychological need satisfaction over the course of the 10-week exercise class
14 program, the social-contextual characteristics were added simultaneously into the model for
15 each psychological need (i.e., model d, Table 6). However, comparing the results of the
16 multilevel regression analyses with data derived from simple correlation analyses suggested
17 that the model for competence need satisfaction was marked by net suppression (Cohen &
18 Cohen, 1983).² To test for suppression effects, each variable (i.e., autonomy support,
19 structure, and interpersonal involvement) was modeled separately as a predictor of
20 competence need satisfaction. The problematic B 's emerged in the opposite direction to that
21 observed in the original model, and thus, net suppression was confirmed. Consequently, the B
22 values derived from the three separate models are reported in Table 6.

23 As can be seen in Table 6, none of the social-contextual characteristics emerged as
24 significant predictors of any of the psychological needs. Further, the effects of these variables
25 did not vary significantly over time. However, for each need, relevant level 2 variance

1 components decreased compared to previous models. This suggests that the inclusion of the
2 social-contextual characteristics improved model fit.

3 *Conditional growth models: Motivational regulations*

4 Intercepts for participants in the SDTc differed significantly to those in the RCc for
5 intrinsic motivation ($B = -0.47, p < .01$), and identified ($B = -0.39, p < .05$) and introjected ($B =$
6 $0.46, p < .05$) regulation (i.e., model b). The participants in the SDTc started the intervention
7 with lower levels of autonomous motivation (i.e., intrinsic motivation and identified
8 regulation) and higher levels of introjected regulation. For those women in the RCc,
9 introjected regulation demonstrated a significant linear increase ($B = 0.29, p < .01$), and
10 amotivation a significant linear decrease ($B = -0.22, p < .001$), over time. The SDTc did not
11 differ to the RCc in terms of the rate of change observed for any of the motivational
12 regulations. It should be noted, however, that the difference between the SDTc and RCc in
13 the rate of change of identified regulation did approach significance ($B = 0.21, p = .06$).

14 To delineate the variables that predicted each of the different types of motivational
15 regulation, the social-contextual characteristics and psychological needs were added
16 simultaneously to each of the motivational regulation models (i.e., model d; Table 7).
17 Utilizing the principles outlined previously, the model for external regulation indicated net
18 suppression (Cohen & Cohen, 1983). Entering each variable separately into the model, whilst
19 controlling for condition, confirmed these effects. Consequently, the β 's reported
20 subsequently are derived from the models where each predictor variable (i.e., autonomy
21 support, structure and interpersonal involvement, autonomy, relatedness and competence)
22 was entered separately. Consequently, the B values derived from each separate model are
23 reported in Table 7.

24 As seen in Table 7, structure emerged as a positive, and interpersonal involvement as
25 a negative, predictor of integrated regulation. Autonomy need satisfaction emerged as a

1 negative predictor of identified regulation. The effect of autonomy support and autonomy
2 need satisfaction on intrinsic motivation, integrated regulation and identified regulation,
3 varied significantly over time. Plotting these interactions revealed that the effect of autonomy
4 support and autonomy became more positive over the course of the 10-week exercise
5 program for the three most autonomous forms of motivational regulation. The effect of
6 interpersonal involvement on introjected regulation also became more positive with time. In
7 general, relevant level 2 variance components dropped in model d, compared to model b,
8 suggesting improved goodness of fit when controlling for the SDT-based antecedents of the
9 motivational regulations.

10 *Conditional growth models: Behavioral, cognitive and affective outcomes*

11 The participants in the SDTc started the exercise program with significantly lower
12 levels of positive affect derived from exercise ($B = -0.34, p < .05$). Inspection of the growth
13 trajectories demonstrated that in the RCc behavioral intention ($B = -0.77, p < .001$) and
14 commitment ($B = -0.24, p < .01$) decreased over time³. The SDTc demonstrated a significant
15 linear increase in enjoyment ($B = 0.26, p < .01$) and positive affect ($B = 0.25, p < .01$) over
16 time, but there were no significant differences in the rates of change compared to the RCc for
17 any of the other study variables.

18 Next, controlling for the effect of condition, we examined the variables proposed by
19 SDT (i.e., the social-contextual characteristics, psychological needs and motivational
20 regulations) to predict adaptive behavioral, cognitive and affective outcomes (i.e., model d,
21 Table 8). Net suppression effects were identified and confirmed for all outcome variables.
22 The procedures detailed previously were utilized to overcome these problems.

23 Autonomy support, structure, and interpersonal involvement positively predicted
24 behavioral intention. Amotivation was a negative predictor. Further, autonomy was found to
25 be a negative, and identified regulation a positive, predictor of enjoyment. Integrated

1 regulation emerged as a positive predictor of positive affect. Competence negatively
2 predicted, and external regulation and amotivation positively predicted, negative affect.
3 Further, the effect of external regulation on total exercise varied significantly over time.
4 Plotting this interaction revealed that the effect became more positive over the course of the
5 10-week exercise program. The effect of structure, interpersonal involvement, intrinsic
6 motivation and amotivation on behavioral intention also varied significantly over the three
7 measurement occasions. Plotting these interactions revealed that the effect of structure and
8 interpersonal involvement on behavioral intention became less positive, whereas the effects
9 of intrinsic motivation and amotivation became more positive, as the exercise program
10 progressed.

11 *Difference between conditions in attendance*

12 To examine differences between the two classes in terms of adherence to the program,
13 we conducted an independent samples t-test. A significant difference was revealed between
14 groups ($t(54) = -2.04, p < .05$), with participants in the SDTc ($M = 6.52, SD = 2.66$) attending
15 significantly more often than those in the RCc ($M = 5.19, SD = 2.21$). This difference was
16 calculated to reflect a medium effect size (d) of 0.54 (Howell, 2002; p. 204-206).

17 Discussion

18 The current study aimed to determine whether, in contrast to a realistically controlling
19 teaching style, it is possible to manipulate autonomy supportive, structural and interpersonal
20 facets of an exercise instructors teaching style, in a real-life exercise setting. In addition, we
21 examined whether the manipulated environment (i.e., SDTc), in contrast to a standard
22 exercise class environment (i.e., RCc), impacted changes in psychological need satisfaction,
23 autonomous motivational regulations for exercise, and adaptive behavioral, cognitive, and
24 affective outcomes over the course of the 10-week exercise class program. Finally, we also
25 explored whether, over time, the social-contextual characteristics proposed by SDT predicted

1 psychological need satisfaction, and whether these, collectively, predicted autonomous,
2 versus controlling, motivational regulations. Moreover, we also examined whether the social-
3 contextual characteristics, psychological needs, and motivational regulations, predicted
4 behavioral, cognitive, and affective outcomes over the course of the 10 week program.

5 *Creating an exercise environment based on SDT's propositions*

6 The results demonstrate that it is possible to enhance perceptions of autonomy
7 support, structure and interpersonal involvement in the exercise class setting. This was
8 revealed via participant self-reports as well as by ratings provided by two independent
9 observers. At week 1, the levels of autonomy support, structure and interpersonal
10 involvement reported by participants in the RCc and SDTc were not statistically different.
11 This was expected considering that week 1 constituted a baseline for the study, and thus, the
12 exercise class instructor taught both classes in accordance with her normal teaching style.
13 This finding is desirable considering that random allocation of participants was not possible.

14 Perceptions of structure and interpersonal involvement did not change over time in the
15 RCc, whereas they increased significantly in the case of the SDTc. This suggests that the RCc
16 was not, from a structural and interpersonal involvement perspective, substantially different
17 to the instructor's normal teaching style. This finding supports the ecological validity of our
18 research by suggesting that the RCc condition reflects what would normally be observed in
19 the exercise domain. Further, the results for the participants in the SDTc demonstrate that it is
20 possible to enhance the socio-contextual characteristics of an exercise instructor's behavior
21 beyond seemingly 'typical' levels.

22 The level of autonomy support perceived by participants in the RCc decreased
23 significantly with time. However, it is important to note that the levels of autonomy support
24 reported during week 1 were quite high, suggesting that the exercise instructor's normal
25 teaching style was relatively autonomy supportive. Although the level of autonomy support

1 reported at weeks 5 and 9 decreased, it remained above average (i.e., the mean did not drop
2 below 4, “somewhat true”, on the 1 – 7 point scale at weeks 5 and 9). Thus, the RCc
3 condition could not be considered as providing an unrealistically low, or potentially
4 detrimental, level of this social-contextual characteristic. In contrast, for participants in the
5 SDTc, perceived autonomy support increased significantly over time compared to the RCc.
6 This suggests that, similar to structure and interpersonal involvement, it is possible for
7 teachers to provide, and maintain, heightened levels of autonomy support in an exercise class.

8 *Facilitating adaptive motivational processes and outcomes*

9 Whilst the aforementioned findings are encouraging, they do not tell us whether the
10 provision of these environmental characteristics engenders desirable consequences. Thus,
11 controlling for condition, subsequent MLA models examined baseline levels and changes
12 over time in reported psychological need satisfaction, motivational regulations, and
13 behavioral, cognitive and affective outcomes.

14 Participants in the RCc reported no change in autonomy and relatedness need
15 satisfaction, but demonstrated a significant linear increase in competence need satisfaction,
16 over the course of the program. The former findings support our hypotheses and appear to
17 add credence to our claims that the teaching style in the RCc reflected the normal behavior of
18 the exercise instructor. The latter finding was not expected. However, it is understandable
19 that, as long as the exercise is not too complex or demanding, simply being involved in an
20 exercise program is likely to increase class participants’ feelings of competence.

21 Supporting the propositions of SDT, compared to the RCc, the SDTc demonstrated a
22 significant linear increase in relatedness and competence need satisfaction over time.
23 However, autonomy need satisfaction did not exhibit a significant rate of change, when
24 compared to the RCc. It is possible that no group differences in growth trajectories emerged
25 with regard to autonomy need satisfaction because of the participant recruitment procedures.

1 All participants in the current study chose to sign up to their exercise class of their own will,
2 and hence, should have felt autonomous towards their exercise engagement. This suggestion
3 is supported by the observation that autonomy was the most highly satisfied need across both
4 conditions and on all three measurement occasions.

5 Teaching style did not significantly impact autonomous motivation. Again, this may
6 not be considered surprising given that the participants voluntarily enrolled in the two
7 exercise classes. However, we should note that the difference in the rate of change of
8 identified regulation between the two conditions did approach significance. This suggests that
9 by providing additional autonomy support, structure and interpersonal involvement it is
10 possible to further heighten enhance exercisers' valuation of exercise. An examination of
11 mean scores also suggests that intrinsic motivation was highly endorsed by both groups and
12 across all three measurement occasions. That is, the exercise activity was perceived as
13 equally pleasurable across groups. Collectively, these findings may imply that SDT-based
14 exercise interventions may be more successful when the activities under investigation are the
15 outcome of external pressure, have yet to become internalized by individuals, or are not
16 intrinsically interesting and enjoyable.

17 For both groups, introjected regulation increased, whilst amotivation decreased, over
18 time. It is common, and sometimes may be considered necessary, for exercise and health
19 professionals to utilize relatively controlling techniques whilst attempting to engage
20 individuals in a specified behavior. For example, an exercise instructor may need to take
21 control of the class and to dictate the pace of an exercise to ensure that no participant is
22 risking injury. Such controlling behaviors would be postulated by SDT (Deci & Ryan, 1985)
23 to lead to an increase in more controlling forms of motivational regulation, such as
24 introjected regulation.

1 In explicating the decrease in amotivation observed across groups, it is important to
2 examine the proposed antecedents of this type of motivation. Amotivation is assumed to arise
3 from a lack of perceived contingency between a behavior and desirable outcomes, a failure to
4 value the behavior, or feeling that one is not competent to successfully engage in it (Ryan &
5 Deci, 2002). These scenarios were unlikely to have been encountered in either of the exercise
6 environments created in the current study. Instead, involvement should have provided an
7 understanding and experience of some of the benefits associated with exercise. Furthermore,
8 perceptions of competence in both environments were relatively high.

9 This study also explored the behavioral, cognitive and affective responses to the
10 SDTc and RCc leadership styles. First, a significant difference in attendance was observed,
11 with those in the SDTc condition attending more regularly than those in the RCc. Based on
12 Hunter and Schmidt's (1990) suggestion that effective psychological interventions usually
13 have an effect size of 0.20 - 0.40, the effect size observed in the current study (i.e., $d = 0.54$)
14 highlights the potential for behavioral change stemming from SDT-focused interventions in
15 the exercise domain. Second, compared to the RCc, participants in the SDTc exhibited a
16 significant increase in reported enjoyment of the class, and positive affect derived whilst
17 exercising, over the course of the 10-week exercise program. Taken together, these findings
18 have important public health implications because they demonstrate that interventions
19 grounded in SDT can enhance exercise adherence and facilitate positive exercise experiences.

20 Contrary to the theoretical propositions of SDT (akin to the RCc), behavioral
21 intention and commitment decreased over time in the SDTc. In understanding these findings,
22 we should note that the majority of participants recruited in the current study were students.
23 The observed reduction in behavioral intention and commitment may have reflected a
24 realization of how hard it is to adhere to an exercise class program whilst embracing the work
25 and social commitments that accompany university life. It is also possible that the wording of

1 the items used at weeks 1 and 6, which were specific to participation in the 10-week exercise
2 program *per se*, compared to week 10, which measured intention to take part in classes run by
3 the instructor in the future, impacted the results obtained. Indeed, supplementary analysis
4 revealed that those in the RCc demonstrated a significant drop in behavioral intention from
5 weeks 1 – 6, whilst those in the SDTc did not. In relation to their current exercise program
6 then, more controlling styles of teaching brought about less desirable cognitive outcomes.

7 It is also important to indicate that the results obtained for commitment and adherence
8 were actually contradictory in nature. With regard to commitment, all participants thought
9 that they would exercise less over time, but in reality (i.e., in terms of adherence), this was
10 more of the case for the RCc. This finding may suggest that whilst both groups were aware of
11 the difficulties and barriers they face in terms of continued exercise participation, teaching in
12 accordance with the propositions of SDT reduced the impact that these negative cognitions
13 had on subsequent behavioral investment.

14 *The processes underpinning psychological need satisfaction, motivational regulations, and*
15 *adaptive behavioral, cognitive and affective exercise related outcomes.*

16 This study also examined the processes underpinning psychological need satisfaction,
17 motivational regulations, and adaptive behavioral, cognitive and affective exercise-related
18 outcomes over the course of the 10-week exercise class program. Structure emerged as a
19 significant predictor of competence need satisfaction, a finding which is consistent with the
20 positions of Reeve (2002). It is understandable how the provision of structure could enhance
21 competence need satisfaction. For example, when exercise class leaders demonstrate good
22 leadership and provide optimal challenge, this would be expected to lead to skill
23 enhancement and increased efficacy. Also supporting SDT's propositions (Deci & Ryan,
24 1985; Ryan & Deci, 2002), competence need satisfaction emerged as a negative predictor of
25 negative affect, whereas the least autonomous forms of motivation (i.e., external regulation

1 and amotivation) emerged as positive predictors. Amotivation was negatively associated with
2 behavioral intention, whereas integrated and identified regulation emerged as positive
3 predictors of positive affect and enjoyment, respectively. In addition, autonomy support,
4 structure and interpersonal involvement were positively linked to behavioral intention,
5 suggesting that these environmental characteristics have a direct effect on key cognitive
6 aspects of the exercise experience.

7 The interaction effects observed in the current study also warrant discussion. For
8 example, the beta weight for intrinsic motivation became more positive in the prediction of
9 behavioral intention and enjoyment over the course of the 10-week exercise program. These
10 findings appear to support the internalization process (Deci & Ryan, 1985, 1991; Deci,
11 Eghrari, Patrick & Leone, 1994), and suggest that, as time progresses, the most autonomous
12 forms of motivational regulation should become more prominent in the prediction of adaptive
13 responses to exercise. Moreover, the regression weights for autonomy support and autonomy
14 need satisfaction became more positive over time in the prediction of the three most self-
15 determined forms of motivational regulation (i.e., identified and integrated regulation and
16 intrinsic motivation). These findings show the important role of the social contextual
17 characteristics and need satisfaction in facilitating the internalization process (Deci & Ryan,
18 2000).

19 In contrast to theoretical propositions however, the beta weight observed for external
20 regulation as a predictor of reported general exercise behavior, became more positive over the
21 10-week exercise program. In this finding it should be noted that the motivational regulations
22 reported by study participants were specifically worded in reference to the exercise class. The
23 fact that they were not relevant to overall exercise makes the interpretation of the interaction
24 at the end of the program difficult.

25 *Conclusions*

1 The findings of the current study indicate that the social-contextual characteristics
2 advanced by SDT can positively influence behavior, cognitions, and affect in a ‘real world’
3 exercise setting. Consequently, the present research supports the external validity of SDT’s
4 theoretical framework in relation to exercise (Mook, 1983). Moreover, in accordance with
5 SDT (Deci & Ryan, 1985; Koestner & Losier, 2002; Reeve, 2002), the hypothesized
6 interdependencies between the socio-contextual characteristics, psychological need
7 satisfaction, motivational regulations and related outcomes were also supported. Whilst our
8 findings have good ecological validity, further randomized controlled studies which use more
9 stringent experimental procedures should attempt to replicate our findings. Furthermore,
10 given the unexpected change in autonomy support observed in the RCc, which, should have
11 remained stable as was the case for structure and interpersonal involvement, future research
12 trials may also benefit from establishing baseline levels of autonomy support, structure and
13 interpersonal involvement over a longer period of time (as opposed to one session) to ensure
14 that perceptions of these socio-contextual variables are captured accurately. Such work will
15 provide a theoretical and empirical rationale for the development of SDT-focused behavioral
16 interventions within the exercise domain.

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Footnote

¹ In addition to the models presented in the current manuscript, to observe group differences in each of the study variables at the end of the exercise program, we also ran models with the data centered the data at week 10. This analysis revealed that, upon completion of the exercise program, the RCc and SDTc did not differ significantly in any of the variables under examination. A more controlling environment may have revealed significant differences, but such manipulations would have jeopardized the external validity of the current experiment.

² Net suppression occurs when a correlation between two independent variables suppresses the real effect of each variable on the criterion variable under examination, and consequently, regression coefficients are reduced or emerge in the opposite direction to that indicated by simple correlation coefficients. As net suppression effects are common in the testing of complex models (Cohen & Cohen, 1983), we computed Pearson's correlations between the average scores of all of the study variables across the three time-points. This gave us an indication of the sign of the relationships between variables. When a *B* coefficient was observed to emerge in the opposite direction to that indicated in the correlation analyses, net suppression effects were explored.

³ The measure of behavioral intention used at the third, and final, measurement point (i.e., week 10) was worded differently to that utilized at weeks 1 and 6. During weeks 1 and 6 the items referred to participants' intention to continuing participating in the exercise class until the end of the course (i.e., the 10 weeks that participants had signed up for). However, at the last measurement point (i.e., week 10) the items tapped whether participants intended to join exercise classes run by their present instructor in the subsequent term. It was recognized that this distinction may have impacted the findings observed. As would be hypothesized by SDT, separate paired samples t-tests revealed that from weeks 1 – 6 the RCc decreased significantly in their behavioral intention to continue partaking in the exercise group (week 1

$M = 6.85$ ($SD = 0.09$), week 6 $M = 6.33$ ($SD = 0.21$); $t(12) = 2.49$, $p = .03$). The SDTc did not (week 1 $M = 6.64$ ($SD = 0.20$), week 6 $M = 6.50$ ($SD = 0.15$); $t(13) = 0.82$, $p = .43$).

Table 1.

Examples of Manipulations in Self-Determination Theory Based Condition

Dimension	Characteristic	Application
Autonomy support	1. Provide choice	1. Provide options about the pace, frequency and type of exercise when possible
	2. Be supportive and praise improvement	2. Praise improvement in techniques and fitness
	3. Acknowledge and take into account students' feeling and perspectives	3. Be open to complaints and respond to them in a positive manner
	4. Provide meaningful rationale	4. Explain why each activity is beneficial, what areas of the body and fitness are working and what areas will improve
Structure	1. Demonstrate good leadership	1. Set goals at the start of the class
	2. Answer questions well and directly	2. As stated
	3. Provide optimal challenge	3. Work at a level that pushes participants to the maximum but accommodate for those less able; provide easy and hard options
Interpersonal involvement	1. Dedicate resources to participants	1. Spend time chatting at the start of class, learn their names and show enjoyment
	2. Ensure close proximity	2. Mix with the class; don't dominate at the front
	3. Recognize interest and disinterest	3. If a problem arises, discuss and amend it; try and re-engage with the class and don't keep ploughing on regardless

Table 2.

Examples of Manipulations in the Realistically Controlling Condition

Characteristic	Application
1. Assign tasks	1. Do not provide choices about the type of exercises to be undertaken
2. Take charge	2. Set the pace and speed of what class does and for how long
3. Provide performance feedback	3. Praise those who complete the highest number of sets
4. Minimize rationale	4. Tell participants what is required but don't give additional information about why they have been asked to do it
5. Tell the participants how they should be thinking, feeling and acting	5. Tell participants where the exercise should hurt, and how they should respond to it, but don't explain why they are being told to do the exercise and how they will benefit from it

Table 3.

Reliability Analyses (Cronbach's coefficient α) and Descriptive Statistics for the Social-Contextual Characteristics at Weeks 1, 5 and 9, by Condition

Variable <i>M</i>			Week 1		Week 5		Week 9			
			RCc	SDTc	RCc	SDTc	RCc	SDTc		
Participant (self-reported)	Range	α	<i>M</i>	<i>M</i>	α	<i>M</i>	<i>M</i>	α	<i>M</i>	<i>M</i>
			(<i>SD</i>)	(<i>SD</i>)		(<i>SD</i>)	(<i>SD</i>)		(<i>SD</i>)	(<i>SD</i>)
Autonomy support	1 – 7	.78	5.90	5.60	.94	4.48	6.59	.91	5.08	6.33
			(1.17)	(1.21)		(1.22)	(0.50)		(1.33)	(0.40)
Structure	1 – 7	.85	5.16	4.98	.84	5.21	5.68	.89	5.13	5.59
			(1.04)	(1.45)		(1.78)	(0.75)		(1.35)	(0.72)
Interpersonal involvement	1 – 7	.95	4.97	4.79	.92	5.04	5.66	.96	5.17	5.63
			(1.22)	(1.44)		(1.40)	(0.85)		(1.61)	(0.86)
Independent observer										
Autonomy support	1 – 7	-	4.50	5.13	-	2.75	5.63	-	2.25	5.88
			(1.41)	(0.88)		(0.71)	(0.18)		(0.35)	(0.18)
Structure	1 – 7	-	5.40	5.30	-	3.70	5.50	-	4.20	6.10
			(0.00)	(0.71)		(0.99)	(0.14)		(0.57)	(0.14)
Interpersonal involvement	1 – 7	-	4.88	4.75	-	3.13	5.63	-	3.25	5.63
			(0.88)	(0.35)		(0.18)	(0.18)		(0.00)	(0.88)
Active engagement	1 – 7	-	4.00	4.70	-	4.50	4.90	-	4.70	5.70
			(0.00)	(0.42)		(0.14)	(0.71)		(0.99)	(0.42)

Note: RCc = Realistically controlling condition, SDTc = Self-determination theory based condition. Cronbach alpha values could not be computed for the variables rated by the independent observers as there were too few observations.

Table 4.

Reliability Analyses (Cronbach's coefficient α) and Descriptive Statistics for Psychological Need Satisfaction, Motivational Regulations and Behavioral, Cognitive and Affective Outcomes at Weeks 1, 6 and 10, by Condition

Variable <i>M</i>	Week 1			Week 6			Week 10			
	Range	α	RCc <i>M</i> (<i>SD</i>)	SDTc <i>M</i> (<i>SD</i>)	α	RCc <i>M</i> (<i>SD</i>)	SDTc <i>M</i> (<i>SD</i>)	α	RCc <i>M</i> (<i>SD</i>)	SDTc <i>M</i> (<i>SD</i>)
Autonomy	1 - 7	.72	5.56 (1.28)	4.85 (1.44)	.71	5.61 (1.16)	5.42 (1.07)	.61	5.59 (1.35)	5.39 (1.06)
Relatedness	1 - 7	.91	5.11 (1.27)	4.60 (1.51)	.73	5.44 (1.07)	5.38 (0.79)	.93	5.40 (1.28)	5.72 (0.84)
Competence	1 - 7	.85	4.54 (1.30)	3.80 (1.44)	.78	5.22 (1.23)	5.18 (0.90)	.75	5.33 (1.08)	5.61 (0.69)
Amotivation	0 - 4	.73	0.45 (0.70)	0.37 (0.57)	.57	0.13 (0.29)	0.27 (0.45)	.87	0.03 (0.08)	0.13 (0.17)
External regulation	0 - 4	.77	0.50 (0.66)	0.68 (0.85)	.81	0.35 (0.39)	0.70 (0.90)	.84	0.58 (0.98)	0.71 (0.83)
Introjected regulation	0 - 4	.67	1.34 (0.91)	1.76 (0.78)	.69	1.61 (0.75)	2.04 (1.03)	.80	2.10 (1.03)	1.89 (1.00)
Identified regulation	0 - 4	.68	3.15 (0.55)	2.75 (0.68)	.80	3.48 (0.45)	3.10 (0.69)	.82	3.30 (0.72)	3.13 (0.81)
Integrated regulation	0 - 4	.66	2.49 (0.86)	2.21 (0.66)	.81	2.48 (0.63)	2.37 (1.15)	.92	2.87 (0.92)	2.38 (1.25)
Intrinsic	0 - 4	.83	3.25	2.78	.74	3.48	3.05	.92	3.38	3.04

motivation			(0.67)	(0.59)		(0.54)	(0.37)		(0.81)	(0.50)
Total exercise	-	-	43.32	45.92	-	44.31	51.93	-	58.88	57.92
			(18.91)	(22.96)		(16.90)	(28.96)		(20.07)	(30.23)
Behavioral	1 – 7	.92	6.44	6.48	.67	6.33	6.47	.87	4.67	5.67
intention			(0.74)	(0.79)		(0.75)	(0.55)		(1.52)	(1.33)
Commitment	1 – 5	.65	3.98	3.96	.74	4.10	4.07	.79	3.50	3.63
			(0.64)	(0.49)		(0.75)	(0.45)		(0.67)	(0.53)
Enjoyment	1 – 5	.86	3.87	3.65	.89	3.90	3.73	.75	3.58	3.79
			(0.69)	(0.73)		(0.95)	(0.67)		(0.71)	(0.41)
Positive affect	1 – 5	.81	3.79	3.48	.90	3.88	3.59	.82	3.67	3.72
			(0.59)	(0.50)		(0.76)	(0.55)		(0.57)	(0.51)
Negative	1 - 5	.75	1.37	1.38	.83	1.21	1.17	.86	1.52	1.18
affect			(0.40)	(0.38)		(0.22)	(0.25)		(0.69)	(0.20)

Note: RCc = Realistically controlling condition, SDTc = Self-determination theory based condition. No α values are provided for total exercise as this is a single-item variable.

Table 5.

Multilevel Regression Analyses showing initial levels and changes over time in Autonomy Support, Structure, and Interpersonal Involvement in the two Exercise Classes (RCc = 0, SDTc = 1)

		Autonomy support	Structure	Interpersonal Involvement
Fixed effects				
Initial status				
	Intercept	5.76*** (0.20)	5.180*** (0.21)	4.97*** (0.22)
	Condition	-0.07 (0.30)	-0.159 (0.31)	-0.12 (0.33)
Rate of change				
	Intercept	-0.65*** (0.15)	-0.058 (0.14)	0.09 (0.15)
	Condition	1.25*** (0.23)	0.555* (0.22)	0.49* (0.22)
Variance components				
Level 1	Within-person	0.73*** (0.14)	0.540*** (0.16)	0.42*** (0.13)
Level 2	In initial status	0.54** (0.20)	0.812** (0.28)	1.15*** (0.31)
	In rate of change	0.00 (0.00)	0.069 (0.13)	0.14 (0.13)
	Covariance	0.00 (0.00)	-0.125 (0.16)	-0.15 (0.16)
Goodness of fit				
	Deviance	321.08	313.07	321.18
	AIC	337.08	329.07	337.18

*Note: * $p < .05$, ** $p < .01$, *** $p < .001$.*

Table 6.

Multilevel Regression Analyses showing initial levels and changes over time in Autonomy, Relatedness and Competence Need Satisfaction in the two Exercise Classes (RCc = 0, SDTc = 1)

	Autonomy	Relatedness	Competence
Fixed effects			
Initial status			
Intercept	5.27*** (0.28)	5.15*** (0.278)	-
Condition	-0.35 (0.41)	-0.46 (0.401)	-
Autonomy support	0.42 (0.29)	-0.11 (0.298)	-0.04 (0.24)
Structure	0.26 (0.48)	0.29 (0.565)	0.20 (0.25)
Interpersonal involvement	-0.55 (0.49)	0.04 (0.567)	-0.07 (0.26)
Rate of change			
Intercept	0.14 (0.25)	0.29 (0.34)	-
Condition	-0.03 (0.33)	0.24 (0.42)	-
Autonomy support	-0.10 (0.41)	0.36 (0.46)	0.44 (0.40)
Structure	-0.20 (0.57)	-0.21 (0.82)	0.06 (0.33)
Interpersonal involvement	0.37 (0.53)	-0.04 (0.84)	0.20 (0.36)
Variance components			
Level 1 Within-person	0.43*** (0.11)	0.63*** (0.17)	-
Level 2 In initial status	1.18*** (0.30)	0.87** (0.29)	-
In rate of change	0.00 (0.00)	0.00 (0.00)	-
Covariance	0.00 (0.00)	0.00 (0.00)	-
Goodness of fit			
Deviance	250.17	247.87	-

AIC	278.17	275.87	-
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Note: * $p < .05$, ** $p < .01$, *** $p < .001$. Due to the procedures undertaken to control for net suppression effects, intercepts, rates of change, variance components, deviances and AIC statistics for the three regression models predicting competence need satisfaction are not reported.

Table 7.

Multilevel Regression Analyses showing initial levels and changes over time in Motivational Regulations in the two Exercise Classes (RCc = 0, SDTc = 1)

	Intrinsic	Integrated	Identified	Introjected	External	Amotivation
Fixed effects						
Initial status						
Intercept	3.30*** (0.130)	2.63*** (0.16)	3.16*** (0.12)	1.36*** (0.18)	-	0.59*** (0.14)
Condition	-0.69*** (0.193)	-0.55* (0.24)	-0.60** (0.17)	0.33 (0.27)	-	-0.30 (0.20)
Autonomy support	-0.11 (0.131)	-0.29 (0.16)	-0.05 (0.11)	-0.07 (0.18)	-0.05 (0.13)	-0.24 (0.14)
Structure	0.27 (0.265)	0.63* (0.29)	0.10 (0.23)	0.07 (0.37)	-0.11 (0.13)	-0.09 (0.28)
Interpersonal involvement	-0.44 (0.258)	-0.56* (0.27)	-0.14 (0.22)	-0.08 (0.36)	-0.10 (0.14)	0.07 (0.28)
Autonomy	-0.16 (0.122)	-0.10 (0.14)	-0.39*** (0.11)	-0.10 (0.17)	0.14 (0.12)	0.11 (0.13)
Relatedness	0.04 (0.202)	0.11 (0.22)	0.31 (0.17)	0.41 (0.28)	0.08 (0.11)	0.08 (0.22)
Competence	-0.07 (0.194)	-0.04 (0.22)	-0.32 (0.17)	-0.29 (0.27)	0.01 (0.10)	-0.06 (0.03)
Rate of change						

Intercept	0.24 (0.134)	0.46* (0.21)	0.38*** (0.11)	0.22 ^a (0.179)	-	-0.24 ^a (0.15)
Condition	-0.13 (0.156)	-0.41 (0.23)	-0.08 (0.13)	-0.033 (0.208)	-	0.28 (0.17)
Autonomy support	0.62** (0.208)	0.90*** (0.26)	0.48** (0.18)	0.47 (0.29)	0.34 (0.24)	0.30 (0.22)
Structure	-0.22 (0.369)	-0.15 (0.40)	0.23 (0.32)	-0.66 (0.51)	0.13 (0.19)	-0.33 (0.39)
Interpersonal involvement	0.34 (0.357)	0.53 (0.37)	-0.13 (0.31)	1.01* (0.49)	0.09 (0.20)	0.29 (0.38)
Autonomy	0.64* (0.301)	1.35*** (0.41)	1.06*** (0.26)	0.64 (0.42)	-0.01 (0.23)	0.07 (0.32)
Relatedness	0.46 (0.318)	0.10 (0.35)	0.00 (0.27)	-0.06 (0.43)	-0.22 (0.15)	0.13 (0.34)
Competence	-0.39 (0.215)	-0.45 (0.24)	-0.09 (0.18)	-0.30 (0.29)	-0.12 (0.13)	-0.14 (0.23)
Variance components						
Level 1 Within-person	0.06*** (0.02)	0.02* (0.01)	0.04*** (0.01)	0.10** (0.03)	-	0.07*** (0.02)
Level 2 In initial status	0.28*** (0.07)	0.49*** (0.10)	0.24*** (0.05)	0.58** (0.13)	-	0.29*** (0.07)
In rate of change	0.00 (0.00)	0.08* (0.04)	0.00 (0.00)	-	-	-
Covariance	0.00 (0.00)	-0.01 (0.06)	0.00 (0.00)	-	-	-
Goodness of fit						
Deviance	106.76	134.48	85.74	158.34	-	115.90

AIC	146.76	174.48	125.74	194.34	-	151.90
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Note. * $p < .05$, ** $p < .01$, *** $p < .001$. ^a Due to convergence problems with the models for introjected regulation and amotivation time was fixed at level 2, and thus no Level 2 variance in rate of change and covariance is reported for these variables. Due to the procedures undertaken to control for net suppression effects, intercepts, rates of change, variance components, deviances and AIC statistics for the regression models predicting external regulation are not reported.

Table 8.

Multilevel Regression Analyses for Total Exercise, Behavioral Intention, Commitment, Enjoyment, Positive affect and Negative affect

	Total Exercise	Behavioral Intention	Commitment	Enjoyment	Positive affect	Negative affect
Fixed effects						
Initial status						
Autonomy support	1.88 (3.37)	0.30* (0.14)	-0.11 (0.12)	0.08 (0.13)	0.01 (0.10)	-0.05 (0.09)
Structure	0.45 (3.31)	0.49* (0.13)	0.02 (0.12)	0.18 (0.13)	0.07 (0.10)	-0.04 (0.07)
Interpersonal involvement	-1.06 (3.33)	0.36* (0.14)	-0.14 (0.12)	0.09 (0.14)	0.00 (0.10)	0.05 (0.07)
Autonomy	-3.62 (3.14)	-0.07 (0.16)	0.04 (0.11)	-0.26* (0.13)	-0.16 (0.11)	0.11 (0.06)
Relatedness	2.55 (2.53)	0.08 (0.15)	0.07 (0.10)	-0.14 (0.12)	0.03 (0.10)	-0.07 (0.05)
Competence	2.46 (2.23)	0.20 (0.13)	0.16 (0.09)	-0.09 (0.10)	0.11 (0.08)	-0.09* (0.04)
Amotivation	-1.21 (8.25)	-1.06** (0.40)	-0.14 (0.28)	-0.17 (0.32)	-0.09 (0.26)	0.43** (0.15)
External	-2.89 (5.01)	-0.15 (0.33)	-0.29 (0.22)	-0.18 (0.25)	0.03 (0.21)	0.26* (0.12)
Introjected	1.49 (5.96)	-0.02 (0.32)	-0.21 (0.20)	-0.02 (0.23)	-0.03 (0.19)	0.08 (0.11)
Identified	-8.87 (7.06)	0.38 (0.41)	0.05 (0.28)	0.77* (0.30)	0.38 (0.24)	0.04 (0.15)
Integrated	4.22 (3.87)	0.12 (0.35)	0.04 (0.17)	0.21 (0.19)	0.30* (0.15)	0.04 (0.09)

Intrinsic	-15.27 (7.99)	-0.31 (0.46)	-0.14 (0.33)	0.68 (0.35)	0.44 (0.28)	-0.09 (0.16)
Rate of change						
Autonomy support	3.46 (7.29)	0.12 (0.31)	0.28 (0.19)	0.16 (0.22)	0.17 (0.16)	0.08 (0.09)
Structure	0.07 (4.85)	-0.41* (0.19)	-0.00 (0.15)	-0.04 (0.18)	0.03 (0.13)	0.00 (0.08)
Interpersonal involvement	-1.80 (5.12)	0.51* (0.22)	0.04 (0.16)	-0.06 (0.17)	-0.02 (0.14)	0.022 (0.08)
Autonomy	15.62 (8.66)	0.35 (0.33)	0.17 (0.21)	0.17 (0.22)	0.40* (0.20)	-0.15 (0.09)
Relatedness	-1.34 (3.91)	-0.10 (0.23)	-0.11 (0.14)	0.08 (0.15)	0.08 (0.13)	-0.11 (0.08)
Competence	0.87 (2.95)	-0.25 (0.18)	-0.12 (0.16)	0.15 (0.13)	0.11 (0.11)	0.02 (0.06)
Amotivation	-4.86 (8.91)	0.98* (0.42)	0.03 (0.28)	-0.10 (0.32)	-0.16 (0.27)	-0.43** (0.13)
External	9.22* (4.55)	0.36 (0.33)	0.33 (0.20)	-0.01 (0.23)	0.14 (0.19)	-0.10 (0.11)
Introjected	3.04 (5.79)	0.19 (0.30)	0.44 (0.24)	0.17 (0.21)	0.22 (0.17)	-0.04 (0.11)
Identified	7.83 (6.90)	0.26 (0.43)	0.20 (0.27)	-0.34 (0.28)	0.15 (0.24)	0.07 (0.15)
Integrated	8.47 (4.52)	0.38 (0.30)	0.26 (0.19)	0.04 (0.22)	0.08 (0.17)	-0.02 (0.11)
Intrinsic	3.66 (9.40)	1.08* (0.52)	0.33 (0.33)	-0.37 (0.36)	0.11 (0.30)	0.16 (0.20)

Note. * $p = .05$, ** $p = .01$, *** $p = .001$. Due to the procedures undertaken to control for net suppression effects intercept, rate of change and variance components, and deviance and AIC statistics are not reported for behavioral, cognitive and affective outcomes.