

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

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Running head: SELF-DETERMINATION THEORY AND EXERCISE

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

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Abstract

1
2 Drawing from self-determination theory (SDT), this study examined the effect of an
3 autonomy supportive, well structured and interpersonally involving teaching style on exercise
4 class participants' psychological need satisfaction, motivational regulations, exercise
5 behaviour, behavioural intention and affect. Female exercise class participants enrolled in a
6 10-week exercise program were exposed to a SDT-based (i.e., SDTc; $n = 25$) or typical (i.e.,
7 control group; $n = 31$) teaching style. The control condition reported a significant decrease in
8 autonomy support, amotivation and behavioural intention over time. In addition, they
9 reported a significant increase in competence and introjected regulation. Compared to the
10 control condition, the SDTc reported a significantly greater linear increase in structure and
11 interpersonal involvement, relatedness and competence need satisfaction and positive affect.
12 Attendance rates were significantly higher in the SDTc. SDT-based social-contextual
13 characteristics and psychological needs predicted autonomous regulations; all these variables
14 collectively predicted adaptive outcomes.

15

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

18 .

19

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

3 Although regular physical activity is conducive to physical and psychological health
4 (Biddle & Mutrie, 2001), less than 30% of adults meet current physical activity
5 recommendations (e.g., Department of Health, 2004). To increase the number of people that
6 engage in, and maintain, a physically active lifestyle, the social psychological factors
7 conducive to exercise adoption and adherence need to be delineated. Self-Determination
8 Theory (SDT; Deci & Ryan, 1985), a contemporary theoretical perspective of human
9 motivation, appears to hold promise for elucidating the socio-contextual and psychological
10 factors influencing participation in physical activity.

11 *Basic psychological need satisfaction and a motivational continuum*

12 SDT assumes that all humans possess three basic psychological needs that are
13 fundamental to the nature and quality of engagement in any given domain (Deci & Ryan,
14 1985), a proposition supported by previous research (e.g., Sheldon, et al., 2001). A need for
15 autonomy reflects a desire to engage in activities of one's choosing and to be the origin of
16 one's own behaviour (deCharms, 1968; Deci & Ryan, 1985). A need for relatedness involves
17 feeling connected to others, or feeling that one belongs in a given social milieu (Baumeister
18 & Leary, 1995; Deci & Ryan, 1985). Finally, a need for competence implies that individuals
19 have a desire to interact effectively with the environment, to experience a sense of effectance
20 in producing desired outcomes and preventing undesired events (Deci & Ryan, 1985).

21 SDT also proposes three categories of motivation: amotivation, extrinsic motivation,
22 (which is itself made up of four different types of regulation: external, introjected, identified
23 and integrated), and intrinsic motivation. Each type of motivation varies with regard to the
24 amount of autonomy associated with it, and thus, lies along a continuum ranging from low to
25 high self-determination (Deci & Ryan 1985).

1 *Amotivation* represents “a state lacking of any intention to engage in a given
2 behaviour” (Deci & Ryan, 1985; Markland & Tobin, 2004a). With *external regulation*, an
3 individual engages in an activity to obtain external rewards or to avoid punishments (Deci &
4 Ryan, 1985). Individuals guided by *introjected regulation* engage in the activity because of
5 internal pressure, feelings of guilt or to attain ego enhancement (Ryan & Deci, 2000).
6 *Identified regulation* reflects participation in an activity because one holds certain outcomes
7 of the behaviour to be personally significant (e.g., improved health). *Integrated regulation*
8 occurs when identified regulations are fully assimilated into the self and are brought into
9 congruence with one’s other values and needs (Deci & Ryan, 2000). *Intrinsic motivation*
10 involves partaking in an activity because it is inherently enjoyable (Deci & Ryan 2000).

11 SDT posits that satisfaction of the basic psychological needs is central to determining
12 the type of regulation guiding behaviour (Deci & Ryan, 2000). Satisfaction of the needs of
13 autonomy and competence are proposed as central to promoting intrinsic motivation. If
14 autonomous forms of extrinsic motivation (i.e., integrated and identified regulation) are to
15 guide behaviour, the needs of autonomy and relatedness must be satisfied. However, when
16 the needs are pitted against one another, or are thwarted, more controlling forms of
17 motivational regulation (i.e., introjected and external regulations) or amotivation ensue (Deci
18 & Ryan, 1985, 2000; Koestner & Losier, 2000). When the psychological needs are satisfied
19 and more autonomous forms of regulation guide behaviour, adaptive behavioural, cognitive
20 and affective responses are expected (Deci & Ryan, 1985; Vallerand, 1997). In contrast, need
21 thwarting and less autonomous forms of regulation are proposed to result in non-optimal
22 outcomes (Ryan & Deci, 2000).

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

24 SDT may be considered a particularly attractive theory for health and exercise
25 professionals attempting to facilitate health behaviour change, as it specifies three socio-

1 contextual variables (i.e., autonomy support, structure and interpersonal involvement) which
2 are held to correspond to variability in psychological need satisfaction, the motivational
3 regulations undergirding behaviour and ensuing motivational outcomes.

4 *Autonomy support* refers to the provision of choice and meaningful rationale from
5 those in a position of authority, acknowledgment of the perspective of others, and
6 minimization of pressure (Deci, Eghrari, Patrick & Leone, 1994). For example, an exercise
7 instructor who is behaving in an autonomy supportive manner will see the situation from the
8 exercisers' perspective, and encourage them to make their own decisions. He/she would not
9 attempt to impose his/her own perspective on them, or attempt to make them change
10 (Williams, Gagne, Ryan & Deci, 2002). When at least two of the components of autonomy
11 support are present, it is postulated that the regulation of behaviour will be accepted by the
12 exerciser as their own, and the most autonomous forms of external regulation will guide their
13 behaviour. If only one or none of these factors are present, partial internalization will occur
14 and less autonomous forms of regulation will arise (Deci et al., 1994).

15 *Structure* describes the extent to which behaviour-outcome contingencies are made
16 understandable, and whether those in a position of authority make their expectations clear and
17 provide feedback (Deci et al., 1994; Deci & Ryan, 1991; Reeve, 2002; Ryan, 1993). Thus, to
18 provide structure, an exercise instructor would set clear goals at the start of the class. To
19 facilitate autonomous regulation, the components of structure should be delivered in an
20 autonomy supportive manner (Deci & Ryan, 1991). For example, in the case of an exercise
21 class, it would be best for the instructor to involve class participants in the goal setting
22 process.

23 Finally, *interpersonal involvement* refers to the quality of the relationship between
24 those in a position of authority and the individuals they interact with, and represents the
25 formers' willingness to dedicate psychological resources, such as time, energy, and affection

1 (Deci & Ryan, 1991; Reeve, 2002). In an exercise class, the instructor would demonstrate
2 interpersonal involvement by recognizing participants' interest and disinterest, and if a
3 problem arose, trying to counter the difficulty and re-engage the class. To derive
4 advantageous outcomes, interpersonal involvement must be also be delivered in an autonomy
5 supportive manner; that is, the authority figure should provide unconditional positive regard
6 which is non-contingent and non-judgmental (Deci & Ryan, 1991).

7 *Previous research examining the socio-contextual characteristics advanced by SDT*

8 Perceived autonomy support has been shown to be positively related to psychological
9 need satisfaction, autonomous regulation and/or adaptive behavioural, cognitive and affective
10 outcomes in the educational (e.g., Reeve, 2002; Reeve et al., 2004; Vansteenkiste, Simons
11 Lens, Sheldon, and Deci, 2004a), health care (e.g., Williams, McGregor, Zeldman, Freedman,
12 & Deci, 2004; Williams, Grow, Freedman, Ryan, & Deci, 1996; Kennedy, Goggin, & Nollen,
13 2004; Williams, Rodin, Ryan, Grolnick, & Deci, 1998) and exercise (e.g., Edmunds,
14 Ntoumanis, & Duda, 2006; Wilson & Rodgers, 2004) domains. Research has also
15 demonstrated that it is possible for teachers to learn how to become more autonomy
16 supportive with students (Reeve, 1998; Reeve, Jang, Carrell, Jeon, & Barch, 2004), and
17 experimental studies have revealed that an autonomy supportive interpersonal counseling or
18 teaching style can predict adaptive motivational and behavioural outcomes in health care
19 (e.g., smoking cessation; Williams et al., 2002, 2006) and exercise (e.g., Vansteenkiste
20 Simons, Soenens, and Lens, 2004b) settings.

21 To our knowledge however, previous SDT-focused studies have only considered the
22 potential advantage of an autonomy supportive interpersonal climate; the socio-contextual
23 characteristics of structure and interpersonal involvement have yet to be considered. Further,
24 studies have examined the effect of autonomy support on only one need [e.g., competence
25 (Williams et al. 2002, 2006) or autonomy (e.g., Vansteenkiste et al. 2004b)], or have used, in

1 the majority of instances, an autonomous motivation composite (Vansteenkiste et al. 2004a;
2 Williams et al. 2002, 2006). Research has yet to delineate the impact of a SDT-based social
3 climate, which incorporates the dimensions of autonomy support, structure and interpersonal
4 involvement, on the satisfaction of the three psychological needs and each of the motivational
5 regulations encompassed within SDT.

6 *Aims and hypotheses of this study*

7 The first objective of the present study was to examine whether an exercise
8 instructor's teaching style can be manipulated so that it is perceived by exercise class
9 participants and independent observers as providing more autonomy support, structure and
10 interpersonal involvement. Given that autonomy support has been defined as a mode of
11 communication that is context free, and research in the educational domain has shown that
12 teachers can be taught how to be autonomy supportive (e.g., Reeve, 1998; Reeve et al, 2004;
13 Williams, et al, 2002, 2006), it was hypothesized that over time an autonomy supportive, as
14 well as a well-structured and interpersonally involved, teaching style (i.e., SDT-focused
15 condition; SDTc) would be rated by exercise class participants and independent observers as
16 providing higher levels of autonomy support, structure and interpersonal involvement,
17 compared to a control condition/ standard practice exercise class environment.

18 The second objective was to examine impact of an exercise class taught in accordance
19 with the socio-contextual variables advanced by SDT on the psychological needs,
20 autonomous motivation, and related outcomes. Based on the literature (e.g., Edmunds et al.,
21 2006; Mageu and Vallerand, 2003), it was also hypothesized that, compared to participants in
22 the control group, those in the SDTc would report significant increases in psychological need
23 satisfaction and self-determined motivation over time. As psychological need satisfaction and
24 autonomous regulation are held to promote adaptive outcomes (Deci & Ryan, 1985), it was

1 composition (i.e., White versus Non-White). Ninety six percent of participants in the SDTc,
2 and 90% in the control group, were university students.

3 *Procedures*

4 This study was approved by the ethics subcommittee of a large UK University. Two
5 intermediate level “cardio combo” (i.e., a mix of boxing choreography and step aerobics)
6 classes constituted the mode of exercise in the current study. Classes were held on a Monday
7 (SDTc) and Wednesday (control) evening, once a week, for 10 weeks. Both classes were run
8 by the same exercise instructor (i.e., a 28 year old White Canadian female, certified by the
9 Canadian Association of Fitness Professionals, with 11 years of teaching experience), in the
10 same venue, throughout the same academic term (i.e., October – December), and at a similar
11 time of the day (i.e., both classes were held in the early evening). As in previous studies of
12 SDT-based interventions in the health care domain (i.e., smoking cessation; Williams et al.,
13 2002), we decided that we would have one exercise instructor delivering both conditions as
14 this would take into account individual differences in treatment styles.

15 Week one class constituted a ‘taster’ session, whereby individuals could try out the
16 exercise class before signing up and paying for the duration of the term. The social-
17 contextual characteristics were not manipulated in this week; the instructor exhibited her
18 typical teaching style. At the end of this first session, the principle investigator informed
19 participants that their class had been selected to take part in a study being conducted at the
20 University. Upon stressing that participation was voluntary, participants were informed that
21 the study aimed to examine personal and psychological characteristics of the exerciser and
22 exercise class leader which can influence the exercise experience. Participants in the SDTc
23 were not informed that the leadership style exhibited in their class was manipulated, and
24 neither class were they told that they would be compared to another class/condition. To act as

1 an incentive, class members were informed that if they agreed to participate and provided all
2 required data, they would be entered into a £50 (approximately \$90 US) prize draw.

3 Those participants that decided to sign up to the class for the duration of the term, and
4 who were willing to take part in the study, provided informed consent (observations of the
5 classes would suggest that this was approximately 70% of members of each class). They also
6 completed an initial questionnaire packet measuring basic demographic variables, perceived
7 autonomy support, structure and interpersonal involvement provided by the exercise
8 instructor, psychological need satisfaction, motivational regulations, behavioral intention, and
9 positive and negative affect (see *Measures* for details). In addition, two trained, independent
10 observers, blind to the experimental conditions, rated the level of autonomy support, structure
11 and interpersonal involvement provided by the exercise instructor in week 1. Moreover, the
12 independent observers also rated the ‘active engagement’ demonstrated by participants in
13 each condition (i.e., the behavioural intensity and emotional quality of participants’
14 involvement in the class; Reeve et al., 2004).

15 From week 2 to the end of the study the exercise class leader manipulated her
16 teaching behaviour to fit the regulatory style selected for each group. In creating the SDTc,
17 the exercise instructor focused upon promoting autonomy support by taking the perspective
18 of the exercise class participants into account, acknowledging their feelings and providing
19 them with pertinent information and opportunities for choice (Deci et al., 1994). Participants
20 in the SDTc were given choice regarding which exercises they wanted to do. These exercises
21 were then replicated in the control condition so that members of the two classes received
22 comparable physical work-outs, reducing the likelihood that class differences in outcome
23 variables could be attributed to differences in physical workload. The use of pressure,
24 demands and extrinsic rewards were also minimized (Black & Deci, 2000; Reeve et al.,
25 2004). Structure was established by providing clear expectations, optimal challenge and

1 timely and informative feedback (Reeve, 2002; Reeve et al, 2004). The exercise instructor
2 dedicated psychological resources to the participants, showing that she was interested in
3 them, and that she was concerned about their well-being (Reeve, 2002; Reeve et al, 2004).
4 The control group was intended to replicate the style of teaching regularly observed in the
5 exercise setting. Although autonomy support, structure and interpersonal involvement were
6 not intentionally promoted in this group, no attempts were made to purposefully undermine
7 participants' experiences in this condition.

8 The same measures of autonomy support, structure and interpersonal involvement
9 completed during week 1, were also rated by participants in weeks 5 and 9. In addition,
10 during weeks 4 and 8, the same independent observers as those utilized in week 1 rated the
11 autonomy support, structure and interpersonal involvement provided by the exercise class
12 leader, and the amount of "active engagement" displayed by the exercise class participants.
13 These measures tested the extent to which the desired social-contextual characteristics were
14 effectively manipulated in the SDTc, versus, control condition. In weeks 6 and 10, the same
15 measures of psychological need satisfaction, motivational regulations, behavioral intention,
16 and affect, as those provided during week 1, were completed by the participants.

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

23 *Measures*

24 *Socio-contextual characteristics.* Exercise class participants' perceptions of autonomy
25 support, structure and interpersonal involvement were assessed using the Perceived

1 Environmental Supportiveness Scale (Markland & Tobin, 2004b). Markland and Tobin have
2 shown these subscales to be internally reliable (Cronbach alpha values were .79, .79 and .78,
3 respectively). In addition, independent observers completed an adapted version of an
4 observation rating scale developed by Reeve et al. (2004) to measure autonomy support,
5 structure and interpersonal involvement provided by the exercise instructor, and the active
6 engagement displayed by exercise class participants. Reeve et al. have shown these sub-
7 scales to possess adequate reliability (i.e., α 's >.81).

8 *Psychological need satisfaction.* Autonomy, relatedness, and competence were
9 measured via the Psychological Need Satisfaction Scale (Markland & Tobin, 2004b).
10 Markland and Tobin have reported Cronbach alpha values of .59, .72 and .69, respectively,
11 for these subscales.

12 *Motivational regulations for exercise.* Participants' motivation to engage in the
13 exercise class was measured using the Behavioural Regulation in Exercise Questionnaire-2
14 (BREQ-2; Markland & Tobin, 2004a). Cronbach alphas for all BREQ-2 subscales have been
15 shown to exceed .75 (Wilson & Rodgers, 2004). The present study also utilized the integrated
16 regulation of Li's (1999) Exercise Motivation Scale. This scale has also been shown to
17 display adequate internal reliability in past work (i.e., α 's >.75; Li, 1999).

18 *Exercise behaviour.* Adherence to the exercise class was measured via a weekly
19 register of attendance, completed by the exercise instructor for each condition.

20 *Behavioural intention.* Behavioural intention to continue participating in the exercise
21 class was assessed using a methodology reported by Wilson and Rodgers (2004). During
22 weeks 1 and 6 this measure assessed participants' intention to continue exercising in their
23 current exercise class. At week 10 (the end of the course), items were worded to assess
24 whether participants intended to join exercise classes run by their present exercise class

1 leader during the following term. Wilson and Rodgers reported an internal consistency of
2 $\alpha = .89$ for this scale.

3 *Positive and negative affect.* The Positive Affect and Negative Affect Scale (PANAS;
4 Watson, Tellegen, & Clark, 1988) was used to measure the positive and negative affect that
5 participants felt while exercising in their class. Watson and colleagues (1988) showed the
6 scale to possess acceptable internal consistencies (i.e., α 's ranged from .86 to .90), good test-
7 retest reliability, and factorial and convergent validity.

8 Results

9 *Reliability analyses and descriptive statistics*

10 Internal consistency estimates and descriptive statistics were computed for all
11 variables at each measurement point for both groups (see Tables 1 & 2). For each
12 questionnaire completed by the exercise class participants, internal consistency coefficients
13 were calculated. In most cases, observed Cronbach alpha's were greater than .70. Bivariate
14 correlations were also computed to assess the reliability of the independent observer ratings,
15 for each variable (i.e., autonomy support, structure, interpersonal involvement and active
16 engagement), across the three measurement occasions, in both conditions. Bivariate
17 correlations ranged from .60 to .99, with the exception of one (i.e., $r = .33$; Mean $r = .78$).
18 However, these correlations should be interpreted with caution as they are based on 2 degrees
19 of freedom only.

20 At week 1, autonomy support was the socio-contextual characteristic perceived most
21 highly by participants in both conditions, followed by structure and then interpersonal
22 involvement. The independent observers rated structure most highly during week 1.
23 Autonomy was the psychological need, and intrinsic motivation the motivational regulation,
24 rated most highly by participants in both conditions in week 1. In general, the mean scores for
25 the socio-contextual variables, psychological needs and autonomous forms of regulation, as

1 well as the outcomes of interest (e.g., positive and negative affect), remained constant or
2 decreased over time for the control group, whereas they increased in the SDTc. The statistical
3 significance of these changes was explored via multilevel analysis.

4 *Multilevel regression analyses*

5 Multilevel regression modeling (MLM), using MLwin (version 2.0; Rasbash et al.,
6 2005), was used to test the main hypotheses. As with standard regression analyses, the aim of
7 MLM is to express the dependent variable as a function of predictor variables. However, the
8 multilevel regression equations specified in this study incorporated two levels of analyses: A
9 within-person equation (or Level 1 model), which is concerned with within-individual change
10 (i.e., how each individual changes over time), and a between-person equation (or Level 2
11 model), which is concerned with inter-individual differences in change (i.e., what predicts
12 differences between people in their rate of change). MLM is particularly useful for the
13 analysis of longitudinal data in which there are several measurements nested within
14 individuals. In this study, the data set was comprised of three weekly observations (weeks 1,
15 5 and 9 for the ratings of autonomy support, structure and interpersonal involvement, and
16 weeks 1, 6 and 10 for all other study variables), nested within study participants. MLM is
17 also suitable when there are missing data (i.e., participants not completing all assessments),
18 as was the case in the present study (see Singer & Willet, 2003 for more information).

19 *Is it possible to manipulate the socio-contextual variables proposed by SDT?*

20 First, we tested conditional growth models examining the effects of the teaching style
21 condition (a dichotomous variable was created, where control = 0 and SDTc = 1) on the
22 intercept and rate of change (i.e., slope) of each social-contextual variable proposed by SDT.
23 In these models, the intercept reflects the level of the dependent variable (e.g., autonomy
24 support) at baseline (the time measure was centered around the baseline) for the control
25 group, whereas the main effect for condition represents the difference in the baseline scores

1 between the two conditions. The slope represents the change in the dependent variables
2 scores in the control group, whereas the interaction between the slope and condition shows
3 the difference in the rate of change of scores between the control and the SDTc over the
4 course of the 10-week program.

5 The SDTc and control group did not differ in baseline levels of the socio-contextual
6 variables. In the control group, autonomy support ($B = -0.65, p < .001$) demonstrated a
7 significant linear decrease over time. The SDTc differed significantly to the control group in
8 autonomy support ($B = 1.25, p < .001$), structure ($B = 0.56, p < .05$), and interpersonal
9 involvement ($B = 0.49, p < .05$); each demonstrated a significant linear increase over time.

10 *Assessing the impact of a SDT-based social context on psychological need satisfaction, the*
11 *motivational regulations and related exercise outcomes.*

12 In line with the models presented above, we then tested conditional growth models
13 examining the effects of the teaching style on the intercept and rate of change (i.e., slope) of
14 each psychological need, motivational regulation and exercise related outcome.

15 *Psychological needs.* Baseline means for autonomy, relatedness, and competence
16 need satisfaction for participants in the SDTc were not significantly different to those in the
17 control group. Competence need satisfaction was the only psychological need to demonstrate
18 a significant change over time in the control group ($B = 0.32, p < .05$). Compared to the
19 participants in the control group, participants in the SDTc displayed a significantly greater
20 linear increase in relatedness ($B = 0.50, p < .05$) and competence ($B = 0.66, p < .01$) need
21 satisfaction. It is important to note that, although non-significant, an inspection of the mean
22 scores revealed that autonomy increased from baseline to weeks 6 and 10 in the SDTc.
23 Moreover, a positive beta weight was observed for autonomy in the SDTc, compared to a
24 negative beta weight for the control group.

1 *Motivational regulations.* Baseline scores for participants in the SDTc differed
2 significantly to those in the control group for intrinsic motivation ($B = -0.47, p < .01$), and
3 identified ($B = -0.39, p < .05$) and introjected ($B = 0.46, p < .05$) regulations. Participants in the
4 SDTc started the intervention with lower levels of autonomous motivation (i.e., intrinsic
5 motivation and identified regulation) and higher levels of introjected regulation. For those in
6 the control group, introjected regulation demonstrated a significant linear increase over time
7 ($B = 0.29, p < .01$), whereas amotivation showed a significant linear decrease ($B = -0.22, p$
8 $< .001$). The SDTc did not differ to the control group in terms of the rate of change observed
9 for any of the motivational regulations; although the betas for the rate of change in integrated
10 regulation and identified regulation were positive in the SDTc and negative in the control
11 condition, and the difference between the SDTc and control group in the rate of change of
12 identified regulation did approach significance ($B = 0.21, p = .06$).

13 *Behavioural, cognitive and affective outcomes:* Participants in the SDTc started the
14 exercise program with significantly lower levels of positive affect derived from exercise ($B =$
15 $-0.34, p < .05$). In the control group, behavioural intention ($B = -0.77, p < .001$) decreased
16 over time¹. The SDTc demonstrated a significantly higher and positive slope for positive
17 affect ($B = 0.25, p < .01$).

18 *Differences in attendance.* An independent samples t-test revealed a significant
19 difference between groups in attendance ($t(54) = -2.04, p < .05$), with participants in the SDTc
20 ($M = 6.52, SD = 2.66$) attending significantly more often than those in the control condition
21 ($M = 5.19, SD = 2.21$). This difference was calculated to reflect a medium effect size ($d =$
22 0.54).

23 *Examining the motivational sequence of SDT*

24 A final group of models examined the main effects of key demographic and
25 psychological predictors on each need, regulation and outcome. These models also examined

1 whether the effects of these predictor variables varied over time. Even if the effect of
2 “condition” was not significant for a particular study variable in the original models, we
3 retained “condition” in these final models, as it constitutes the major independent variable in
4 the current study. Thus, we felt it was important to control for its effect.

5 *Predicting the socio-contextual variables.* Ethnicity and age did not play a role in
6 predicting any of the social contextual characteristics advanced by SDT (Note: ethnicity and
7 age did not emerge as significant predictors in any of the subsequent models, and thus, shall
8 not be discussed further).

9 *Predicting the psychological needs:* The social-contextual dimensions were added
10 simultaneously as predictors of each psychological need. However, the results of the
11 multilevel regression analyses, when compared with data derived from simple correlation
12 analyses, suggested that the model for competence need satisfaction was marked by net
13 suppression (Cohen & Cohen, 1983). Net suppression occurs when a correlation between two
14 independent variables suppresses the real effect of each variable on the criterion variable
15 under examination, and consequently, regression coefficients are reduced or emerge in the
16 opposite direction to that indicated by correlation coefficients. Net suppression effects are
17 common in the testing of complex models (Cohen & Cohen, 1983). To test for suppression
18 effects, each variable (i.e., autonomy support, structure, and interpersonal involvement) was
19 modeled separately as a predictor of competence need satisfaction. The problematic B 's
20 emerged in the opposite direction to that observed in the original model, and thus, net
21 suppression was confirmed. Thus, in interpreting the model for competence need satisfaction,
22 we used the B values derived from the three separate models. For autonomy and relatedness,
23 the predictor variables were entered and assessed simultaneously. None of the social-
24 contextual characteristics emerged as significant predictors of any of the psychological needs.
25 Moreover, the effects of these variables did not vary significantly over time.

1 *Predicting the motivational regulations.* The social-contextual characteristics and
2 psychological needs were then added as predictors of each of the motivational regulations.
3 We found that the models for external, introjected and integrated regulation were also marked
4 by net suppression. Thus, for external, introjected and integrated each predictor variable was
5 entered into, and assessed, separately the model. For all other motivational regulations, the
6 predictor variables were entered and assessed simultaneously.

7 Structure ($B = 0.63, p < .05$) and competence ($B = 0.16, p < .01$) emerged as positive
8 predictors of integrated regulation at baseline. Autonomy ($B = -0.39, p < .001$) emerged as a
9 negative predictor of identified regulation at baseline. The effects of autonomy and autonomy
10 support on identified regulation (autonomy $B = 1.06, p < .001$; autonomy support $B = 0.48, p$
11 $< .01$) and intrinsic motivation (autonomy $B = 0.64, p < .01$; autonomy support $B = 0.62, p <$
12 $.01$) varied significantly over time. The effect of autonomy on integrated regulation ($B = 1.35,$
13 $p < .001$) also varied significantly over time. Plotting these interactions revealed that although
14 autonomy need satisfaction was a negative predictor of identified regulation at baseline, it
15 became a significant positive predictor at weeks 6 and 10. For integrated regulation and
16 intrinsic motivation, autonomy was not a significant predictor at baseline, but it became a
17 significant positive predictor at weeks 6 and 10. The effects of autonomy support on intrinsic
18 motivation and identified regulation were positive on all three measurement occasions.
19 Moreover, this effect increased over time.

20 *Predicting cognitive and affective outcomes.* The SDT-based social-contextual
21 characteristics, psychological needs and motivational regulations were then examined as
22 predictors of exercise class specific behavioural intentions, and exercise related positive and
23 negative affect. Net suppression effects were identified and confirmed for all outcome
24 variables. Thus, each predictor variable was entered into, and assessed separately, for each
25 model/ outcome variable.

1 was expected considering that week 1 constituted a baseline for the study. Thus, the exercise
2 class instructor taught both classes in accordance with her typical teaching style. This finding
3 is desirable considering that random allocation of participants was not possible.

4 The results also demonstrate that it is possible to train an exercise instructor to create
5 a class environment marked by autonomy support, structure and interpersonal involvement.
6 Support for the effectiveness of the manipulation stemmed from participant self-reports as
7 well as by ratings provided by two independent observers. These findings concur with prior
8 research indicating that teachers, and health professionals, can be effectively trained to adopt
9 a self determination centered teaching style (e.g., Reeve, 1998; Reeve et al., 2004; Williams
10 et al., 2002, 2006). In contrast, perceptions of structure and interpersonal involvement did not
11 change over time in the control group, whereas perceptions of autonomy support decreased.
12 The former results make sense as the teaching style manifested in the control condition was
13 intended to reflect the normal behaviour of the exercise instructor. Although decreasing
14 significantly over time, it is important to note that the mean perceptions of autonomy support
15 remained above average for the duration of the 10 week course among control group
16 participants. Thus, the control condition could not be considered as providing an
17 unrealistically low, or potentially detrimental, level of autonomy support.

18 *Facilitating adaptive motivational processes and outcomes*

19 Besides exploring baseline differences and changes in the three socio-contextual
20 characteristics, we were also interested to examine, in each condition, baseline levels and
21 changes over time in reported psychological need satisfaction, motivational regulations, and
22 behavioural, cognitive and affective outcomes. Participants in the control condition reported
23 no changes in autonomy and relatedness need satisfaction, but demonstrated a significant
24 linear increase in competence need satisfaction over the 10-week course. The former findings
25 support our hypotheses but the latter finding was in contrast to predictions. However, it is

1 plausible that, as long as the exercise tasks are not too complex or demanding, being involved
2 in an exercise program would increase class participants' feelings of competence over time,
3 especially for those with a short exercise history.

4 SDTc participants demonstrated a significant linear increase in relatedness and
5 competence need satisfaction over time when compared to the control group. However, their
6 reported autonomy need satisfaction did not exhibit a significantly greater rate of change
7 when contrasted to the responses of those in the control condition. It is possible that the latter
8 finding is due to the participant recruitment procedures. All participants in the current study
9 chose to sign up to their exercise class of their own will, and hence, they probably felt
10 autonomous towards their exercise engagement. This suggestion is supported by the
11 observation that autonomy was the most highly satisfied need across both conditions and all
12 measurement occasions (Table 2).

13 There was no difference between the two conditions in terms of the rate of change of
14 autonomous motivation. However, it is notable that the betas for the rate of change in
15 autonomous motivational regulations in the SDTc condition were positive, as would be
16 expected by SDT (Deci & Ryan, 1985), while negative beta weights emerged for the control
17 group. This trend suggests that a SDT-based teaching style has the potential to enhance the
18 value exercisers place on exercise engagement.

19 For participants in both conditions, introjected regulation increased, whilst
20 amotivation decreased, over time. The latter finding makes sense as, in a context in which
21 attendance is *not* mandatory, it would be unlikely that anyone who was still engaged in the
22 exercise class (and part of the study) through 10 weeks would be higher in amotivation than
23 when they started the class. Amotivation is manifested when the participant lacks the
24 intention for behavioural engagement. In both conditions, as we moved through the 10 week
25 class, those still involved in the class were by definition behaviourally engaged and most

1 likely having their participation fueled by more autonomous or controlling reasons.
2 Amotivation is also held to stem from feelings that one is not competent to successfully
3 engage in a particular activity (Ryan & Deci, 2002). Among the present sample of
4 participants, in both classes, perceptions of competence were relatively high.

5 The observed increase in introjected regulation for SDTc and control group
6 participants is more difficult to explain. It might have been the case that, even when
7 presented with a more self-determination focused class, the ego involvement of the students
8 (perhaps revolving around social pressures regarding one's physique) became more
9 pronounced over the 10 weeks. Previous research has indicated that females tend to be more
10 concerned with appearance-related issues in general (e.g., Pliner, Chaiken & Flett, 1990) and
11 such body image concerns can be heightened in exercise settings (which typically involve a
12 greater exposure of the body due to the clothing required, presence of mirrors, etc.; Martin
13 Ginis, Jung, & Gauvin, 2003). Thus, the female participants in the current study may have
14 used social standards of physique, increasingly so as the exercise program unfolded, to judge
15 their self worth. Ego involvement and contingent other-referenced judgements of self worth
16 are held to be contributors to greater introjection (Deci & Ryan, 2000; Ryan & Brown 2003).
17 It is also important to note that the class sizes in both conditions were moderate. In groups of
18 approximately 30 (or less) led by one instructor over 10 weeks, missing a class would be
19 more noticeable than in exercise programme involving a larger number of participants and
20 multiple instructors. Thus, the observed increase in introjection may have been due to
21 participants feeling more guilty about missing their weekly session as the term progressed.

22 This study also explored the behavioural, cognitive and affective responses to the
23 leadership styles manifested in the SDTc and control conditions. First, a significant difference
24 in attendance was observed; with those in the SDTc condition attending more regularly than
25 those in the control group. Based on Hunter and Schmidt's (1990) suggestion that effective

1 psychological interventions usually have an effect size of 0.20 - 0.40, the effect size observed
2 in the current study (i.e., $d = 0.54$) highlights the potential for SDT-focused interventions to
3 impact behavioural engagement in the exercise domain. Second, compared to the control
4 group, participants in the SDTc exhibited a significant increase in positive affect derived
5 whilst exercising over the course of the 10-week exercise program. Taken together, these
6 findings demonstrate that interventions grounded in SDT can enhance exercise adherence and
7 facilitate positive affective exercise experiences.

8 Contrary to SDT, behavioural intention decreased over time in the SDTc (akin to the
9 control group). It is possible that the different wording of the items used at weeks 1 and 6,
10 which were specific to participation in the 10-week exercise program *per se*, compared to the
11 wording of the items used in week 10, which measured intention to take part in future classes
12 run by the instructor, impacted the results obtained. Supplementary analyses focusing on
13 changes from week 1 to week 6 revealed that those in the control group demonstrated a
14 significant reduction in behavioural intention whilst those in the SDTc did not. In
15 understanding the reduction in intention after week 6 observed in both conditions, we should
16 note that the majority of participants recruited in the current study were students. The
17 decrease in behavioural intention may have reflected a realization of how hard it is to adhere
18 to an exercise program whilst embracing the work (in UK universities, the majority of
19 assessment takes places at the end of term) and social commitments of university life.
20 *Longitudinal relationships between psychological need satisfaction, motivational regulations,*
21 *and adaptive behavioural, cognitive and affective exercise-related outcomes.*

22 This study also examined the longitudinal relationships between psychological need
23 satisfaction, motivational regulations, and exercise-related outcomes over the course of the
24 10-week exercise class program. Structure emerged as a significant predictor of competence
25 need satisfaction, a finding which is consistent with Reeve (2002). Also supporting SDT

1 (Deci & Ryan, 1985; Ryan & Deci, 2002), competence need satisfaction emerged as a
2 negative predictor of negative affect, whereas the least autonomous form of motivation (i.e.,
3 external regulation) and amotivation emerged as positive predictors of the same variable.
4 Amotivation was negatively associated with behavioural intention, whereas integrated
5 regulation emerged as a positive predictor of positive affect. In addition, autonomy support,
6 structure and interpersonal involvement were positively linked to behavioural intention.

7 The beta weights for autonomy support and autonomy need satisfaction became more
8 positive over time in the prediction of the three most self-determined forms of motivational
9 regulation. These findings add credence to Deci and Ryan's (2000) arguments that social
10 contextual characteristics and psychological needs play an important role in facilitating the
11 internalization process (i.e., by becoming more important in the prediction of autonomous
12 regulation over time).

13 As is the case with any piece of research, the present study was marked by a number of
14 limitations. Firstly, the inclusion of participants from a university setting limits the
15 generalizability of the findings. Future studies involving less educated and/or male exercisers,
16 and/or taking place outside of the University setting are warranted. It also should be noted
17 that study participants were not randomized into conditions (and we did not control for
18 variables such as previous exercise involvement). Perhaps as a consequence, participants in
19 the SDTc were observed to start the study with lower levels of autonomous and higher levels
20 of controlling motivation. Subsequent work would benefit from a cluster randomized design
21 which considers levels of potentially important discriminating variables, such as pre-existing
22 psychological need satisfaction, autonomous motivation for physical activity engagement,
23 and past history regarding exercise involvement, on entry to the programme.

24 In addition, we were unable to examine the motivational processes underpinning
25 longer-term exercise engagement. This shortcoming could be rectified in the future by

1 examining whether ‘teaching style’ (i.e., SDT versus control class condition) corresponds to
2 differential participation in exercise classes in subsequent terms. Finally, it is important to
3 emphasize that this study involved only one exercise instructor teaching across two exercise
4 classes. By using the same exercise instructor to deliver both treatment types/ conditions, we
5 were able to control for the personal characteristics of the exercise leader (as advocated by
6 Williams et al., 2002). Manipulation checks confirmed that the environments of the two
7 exercise classes were perceived to be different by class participants. Research is now needed
8 to explore the impact of different instructors, as well as the effect of different class contexts.
9 For example, future work could involve a number of different instructors randomly assigned
10 to a SDT-based training programme or control group (standard practice), and examine the
11 effects of these teaching styles in different exercise settings (University, community, health
12 care) via multi-level analysis. Future work with multiple instructors may also assess the
13 impact of different personality traits on the success of the intervention.

14 *Conclusions*

15 This study represents the first comprehensive experimental test of an SDT-based
16 intervention in a real life setting. The findings suggest that the degree of autonomy-support,
17 structure, and interpersonal involvement provided by exercise leaders can positively
18 influence exercise class participants’ behavioural, cognitive, and affective responses to
19 exercise. Consequently, the present research supports the external validity of SDT’s
20 theoretical framework in relation to exercise (Mook, 1983). The observed interdependencies
21 between the socio-contextual characteristics, psychological needs, motivational regulations
22 and related outcomes were also consonant with the theoretical propositions of SDT (Deci &
23 Ryan, 1985; Koestner & Losier, 2002; Reeve, 2002). Although this research needs to be
24 replicated and expanded, our results should be considered as a first, encouraging step for the
25 application of effective exercise promotion strategies grounded in self-determination theory.

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Footnotes

¹The measure of behavioural 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 continue participating in the exercise class until the end of the course. However, at the last measurement point the items tapped whether participants intended to join exercise classes run by their instructor in the subsequent term. We recognize that this distinction may have impacted on our findings. Thus, we carried out separate paired samples t-tests focusing on the first two time points only. These tests revealed that from weeks 1 – 6 the control group decreased significantly in their behavioural intention to continue partaking in the exercise group. There was no such decrease in the SDTc group.

Table 1.

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

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

Note: C = control group. SDTc = Self-determination theory-based condition. Cronbach alpha values could not be computed for the variables rated by the independent observers as there were only two observations per time point.

Table 2.

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

Variable	Range	α	Week 1		Week 6		Week 10			
			C	SDTc	C	SDTc	C	SDTc		
			<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	α	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)	α	<i>M</i> (<i>SD</i>)	<i>M</i> (<i>SD</i>)
Psychological needs										
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)
Motivational regulations										
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	0 - 4	.66	2.49	2.21	.81	2.48	2.37	.92	2.87	2.38

regulation			(0.86)	(0.66)		(0.63)	(1.15)		(0.92)	(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)
Cognitive and affective outcomes										
Behavioural	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)
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: C = control group, SDTc = Self-determination theory-based condition. No α values are provided for total exercise as this is a single-item variable.