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Adherence and well-being in overweight and obese patients referred to an exercise on prescription scheme: A self-determination theory perspective

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Abstract

Objectives: Based on Self-Determination Theory [SDT; Deci & Ryan, 1985. Intrinsic motivation and self determination in human behavior. New York: Plenum Press], this study examined differences in perceived autonomy support, psychological need satisfaction, self-determined motivation, exercise behaviour, exercise-related cognitions and general well-being, between overweight/obese individuals who demonstrated greater adherence to an exercise on prescription programme and those who adhered less. In addition, this study explored the motivational sequence embedded in SDT by testing autonomy support as a predictor of psychological need satisfaction, autonomy support and psychological need satisfaction as predictors of the motivational regulations, and autonomy support, psychological need satisfaction and the motivational regulations as predictors of behavioural, cognitive and well-being outcomes.
Method: Before commencing, at 1-month, and upon terminating a 3-month exercise on prescription programme, overweight/obese individuals (N = 49; M Body Mass Index = 38.75) completed a multi-section questionnaire tapping all aforementioned variables. Participants' adherence to the scheme was assessed using attendance records.
Results: Multilevel regression analyses revealed that, at the end of the exercise prescription, those individuals who adhered more reported more self-efficacy to overcome barriers to exercise versus those who adhered less. In addition, those individuals who showed greater adherence demonstrated an increase in relatedness need satisfaction over time. For the whole sample, need satisfaction predicted self-determined

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regulation, and collectively, these constructs corresponded to adaptive exercise related outcomes and general well-being throughout the programme.
Conclusions: Based on the results it appears that exercise on prescription schemes would benefit from creating services that foster self-determination via the facilitation of psychological need satisfaction.

Keywords: Autonomy support; Psychological need satisfaction; Self-determined motivational regulations; Exercise; Obesity

Introduction

Obesity now constitutes the second highest cause of preventable disability and death in the developed world (House of Commons Health Committee, 2004). Sedentary lifestyles contribute significantly to the prevalence of overweight and obesity (National Audit Office, 2001). Thus, increasing exercise engagement should be one way in which to tackle the so-called 'obesity epidemic' (WHO, 1998). To achieve this aim, the motivational determinants of exercise participation need to be delineated.

Self-Determination Theory (SDT; Deci & Ryan, 1985, 2000) appears to hold considerable promise for elucidating the social psychological processes influencing exercise participation. SDT postulates that an autonomy supportive context will foster the satisfaction of three basic psychological needs (i.e., the needs for autonomy, relatedness and competence). When these needs are satisfied, it is assumed that self-determined forms of motivational regulation guide behaviour (i.e., intrinsic motivation and integrated and identified regulation) and adaptive behavioural (e.g., exercise engagement), cognitive (e.g., commitment) and well-being (e.g., vitality) outcomes are postulated to ensue. In contrast, diminished need satisfaction elicits less or non self-determined motivation (i.e., introjected and external regulation and amotivation), which in turn, results in maladaptive outcomes.

Basic needs theory, a sub-theory of Deci and Ryan's self-determination framework (Deci & Ryan, 1985), specifically points to the role of the psychological needs in promoting optimal experiences and well-being. Notably, basic needs theory postulates that satisfaction of the three needs in people's immediate situations and in their developmental histories will lead to global well-being and psychological health (Ryan & Deci, 2000). Thus, if an individual's needs for autonomy, relatedness and competence are satisfied in exercise and physical activity settings, a sense of overall well-being (e.g., feelings of life satisfaction) or eudaimonia (e.g., subjective vitality) should ensue (see Hagger & Chatzisarantis, this edition, for a more detailed overview of SDT).

Support for SDT in the exercise domain

Previous SDT-focused exercise research has revealed that autonomy support is positively associated with psychological need satisfaction and self-determined regulation of exercise behaviour (e.g., Edmunds, Ntoumanis, & Duda, 2006; Wilson & Rodgers, 2004). Competence need satisfaction has also emerged as a partial mediator of the relationship between autonomy

support and self-determined regulation (Edmunds et al., 2006). Further, need satisfaction has been positively associated with self-determined motivation (e.g., Edmunds et al., 2006; Wilson, Rodgers, & Fraser, 2002). In addition, competence need satisfaction and self-determined regulation have been associated with various positive behavioural (e.g., Edmunds et al., 2006; Landry & Solmon, 2004; Mullan & Markland, 1997; Wilson et al., 2002), cognitive (e.g., Wilson & Rodgers, 2004), and affective (Edmunds, Duda, & Ntoumanis, 2005; Wilson & Rodgers, 2002) aspects of the exercise experience.

Previous SDT-focused exercise studies have been predominantly cross-sectional in design. Consequently, they are restricted in the extent to which they can explicate the motivational mechanisms impacting exercise engagement. For example, it has been suggested that between initial adoption of and adherence to a regular exercise programme, an individual's motivational focus is likely to shift from less to more self-determined (Mullan & Markland, 1997). This postulate stems from the organismic integration theory, a sub-theory of SDT that focuses specifically on the process of internalization (Deci & Ryan, 1985). Thus, it has been suggested that variations in the degree to which individuals internalize the value of exercise may determine those who adhere to exercise programmes over time (Wilson, Rodgers, Blanchard, & Gessell, 2003). Longitudinal methodologies are required to examine this presumed internalization process.

A number of SDT-focused studies in the physical domain have attempted to rectify the aforementioned shortcoming. For example, Pelletier, Fortier, Vallerand, and Briere (2001) examined longitudinally the importance of internalization for behavioural persistence among a sample of 369 competitive swimmers. Supporting the presumed internalization process, introjected regulation predicted persistence in the short-term (i.e., at 10-months), along with intrinsic motivation and identified regulation, but only the latter two predicted persistence for the duration of the 22-month study. Wilson et al. (2003) examined the internalization process among 53 individuals volunteering to engage in a 12-week cardiovascular-based exercise programme. Again supporting the process of internalization, those participants who adhered (i.e., 70% of participants) to their 12-week structured exercise class programme reported moderate to large increases in relatedness and competence need satisfaction, identified regulation and intrinsic motivation.

With respect to SDT-focused exercise research conducted to date (e.g., Edmunds et al., 2006; Wilson & Rodgers, 2004; Wilson et al., 2002, 2003), the trend has been to adopt a primary prevention perspective (i.e., activities that help avoid a given health care problem; US Preventative Services Task Force, 1996). That is, past studies have predominantly sampled active or recently active populations, or volunteers to gain a better understanding of the motivational processes underpinning exercise engagement. Researchers have yet to test the utility of SDT in terms of exercise behaviour from a secondary prevention perspective (i.e., activities for persons who have already developed risk factors or preclinical disease, but in whom the condition is not clinically apparent; US Preventative Services Task Force, 1996). One such group are overweight or obese individuals who are at risk of developing a variety of obesity-related co-morbidities (e.g., Diabetes, Coronary Heart Disease, Stoke and some forms of Cancer; WHO, 1998). In a longitudinal study, Williams, Grow, Freedman, Ryan, and Deci (1996) examined the relationship of autonomy orientation and the degree of autonomy supportiveness of the health care staff to successful weight loss attempts among severely or morbidly obese patients. However, the thrust of the Williams et al. (1996) investigation was a reduction in caloric intake and the outcome of

interest was changes in body weight. The study did not include any exercise intervention. Thus, among a sample of overweight/obese individuals referred by their doctor to an Exercise on Prescription (EoP) scheme to aid weight loss, the present investigation will extend the research of Williams and colleagues by testing the theoretical propositions of SDT with respect to the prediction of adherence to the prescribed exercise programme, exercise-related cognitions and associated well-being.

Aims and hypotheses

The main objective of the current study was to examine whether overweight/obese individuals who adhered more to their exercise prescriptions reported greater levels of autonomy support, psychological need satisfaction and self-determined motivational regulations, versus those who adhered less. Moreover, given that motivational processes are expected to impact a multitude of cognitive, affective and behavioural outcomes (Vallerand, 1997, 2001), this study also examined whether those individuals that adhered more reported greater levels of exercise behaviour, exercise-related cognitions (i.e., self-efficacy, commitment and behavioural intention) and general well-being (i.e., positive and negative affect, subjective vitality and satisfaction with life). We hypothesized that those individuals who adhered more would report higher levels of autonomy support, psychological need satisfaction, self-determined motivation and positive behavioural, cognitive and affective outcomes at 3-months, as well as a greater increase in these constructs over time, compared to those who adhered less.

Secondly, we explored the motivational sequence embedded in SDT by testing autonomy support as a predictor of need satisfaction, autonomy support and need satisfaction as predictors of the motivational regulations, and autonomy support, need satisfaction and the motivational regulations as predictors of behavioural, cognitive and well-being outcomes. We hypothesized that, over time, perceived autonomy support would emerge as a positive predictor of psychological need satisfaction. Autonomy support and psychological need satisfaction were hypothesized to predict self-determined motivation. Further, autonomy support, need satisfaction and self-determined regulation were hypothesized to predict adaptive behavioural and cognitive exercise-related outcomes, as well as well-being, over the course of the 3-month exercise prescription. In this way, we aimed to garner a better understanding of how different facets of SDT impact upon different components of the exercise experience. Such information can be used by practitioners to more effectively facilitate each of these consequences in exercise settings.

Exercise behaviour was chosen as a dependent variable as this is the key outcome of the EoP scheme, and it is a health promotive behaviour of particular concern to public health. As barrier self-efficacy and behavioural intention have repeatedly been shown to predict exercise behaviour (e.g., Hausenblas, Carron, & Mack, 1997; McAuley & Jacobson, 1991), we included them in our study to examine whether these exercise-related variables can be predicted by the SDT constructs. As our measure of behavioural intention related specifically to general exercise, we also chose to include a measure of commitment to the scheme per se. Thus, we aimed to explore changes in participants' cognitions about the scheme itself (i.e., via commitment), as well as their wider exercise behaviour (i.e., via behavioural intention). Finally, indicators of well-being were assessed as SDT research has shown that psychological needs and different motivational regulations are related to different degrees of well-being. More specifically, the variables of positive and negative

affect, satisfaction with life and subjective vitality were chosen as these provide a comprehensive assessment of well-being in accordance with the concept of ''subjective well-being'' in line with the perspective of Diener, Emmons, Larsen, and Griffin (1985) and also the hedonic/eudaimonic conceptualization of well-being as embraced by Deci and Ryan (2001).

Method

Participants

Participants ($N = 49$; 84% female) ranged in age from 16 to 73 years ($M = 44.98$, SD = 14.61). Thirty nine classified themselves as White, five as Black/Black British, and four as Asian/Asian British. The majority were separated or divorced (53.1%). Participants' weight ranged from 70 to 150 kg ($M = 105.68$, SD = 21.32). BMI's ranged from 29 to 58 kg/m^2 ($M = 38.75$, SD = 7.25). An individual with a BMI of 25–30 kg/m^2 is considered as overweight and an individual with a BMI >30 kg/m^2 is classified as obese.

Procedures

The current research was approved by the ethics subcommittee of a large British University. Participants were patients referred by their General Practitioner (Physician) to an EoP scheme run in a large city in the West Midlands, UK. EoP schemes are designed for individuals between 15 and 74 years of age who display specific Coronary Heart Disease risk factors. Upon referral to the scheme, an EoP advisor (i.e., a health and fitness instructor who has received specialized training to deliver exercise prescriptions) develops a 3-month exercise routine to suit each patient's/client's condition.[1]

All participants taking part in this study were referred to the scheme because they were overweight or obese. During an initial consultation with their EoP advisor, during which time the patient's health status is assessed, the exercise prescription process explained and exercise modalities discussed (taking approximately 30–45 min), overweight/obese clients were asked if they would be willing to take part in a study being conducted at a local University. It was stressed to clients that participation was voluntary, that they could drop out at any stage, and that refusal

[1]Patients displaying Coronary Heart Disease risk factors, and who are perceived by their General Practitioner (Physician) as being suitable for the EoP programme, are given a Prescription Card. The patient then makes an appointment with a local EoP advisor who assesses the patients' eligibility/suitability for the scheme. Eligible patients attend an initial consultation with the EoP advisor at their local Leisure Centre which lasts up to an hour (typically 30–45 min). In this consultation the patient and EoP advisor discuss the aim of the scheme, the patients' current medical condition and physical activity status, and the activities on offer at the leisure centre. Height, weight and body composition are assessed and an exercise plan is then devised for the patient. The patient then attends an induction session with the EoP advisor, where they are shown how to follow their exercise prescription and use the facilities and fitness equipment appropriately. The patient is subsequently required to follow their 12-week prescribed exercise plan. Although informal support/contact is maintained in the weeks following these sessions, the EoP advisors attention is then focused upon new referrals. At the end of the 12-week prescription the patient has a final meeting with their EoP advisor to discuss their progress, complete another fitness appraisal if appropriate, and compare their pre- and post-fitness and physical activity levels. A report is also sent to the patients General Practitioner.

to take part or dropping out of the study would not affect their treatment in any way. All participants who participated in the study and returned all required data were entered into a prize draw for one of five £50 cash prizes (approximately $90 US). Participants agreeing to take part provided informed consent, which was returned to the principal investigator.

Following their initial consultation, participants were booked in for their 'fitness induction session'. Prior to this appointment, all participants who had consented to take part in the current study completed an initial (baseline) packet of questionnaires. The assessments tapped basic demographic information (including weight and height, as measured by their EoP advisor), perceived autonomy support, exercise-specific psychological need satisfaction, motivational regulations for exercise, self-reported exercise behaviour, self-efficacy for exercise when faced with barriers, and indicators of well-being (i.e., positive and negative affect, subjective vitality and life satisfaction).

At 1- and 3-month post-entry to the scheme, participants were mailed an additional questionnaire packet which contained the same measures as those assessed at baseline, as well as a measure of commitment to the scheme, behavioural intention to continue exercising, and self-reported weight. The 1-month, as opposed to a 1.5 month (i.e., mid-scheme) or 2-month, measurement point was chosen on the basis of discussions with the EoP staff. Based on their feedback, it became evident that drop out from the scheme was highest in the initial month of the exercise referral. Thus, we felt that the inclusion of a 1-month measurement point would optimize the number of respondents providing a second set of data. That is, it was anticipated that dropouts would be more likely to respond to the questionnaire mail out if this correspondence took place close in time to their last attendance in the scheme.

At the end of each participants 3-month exercise prescription, using a scale utilized by Pelletier et al. (2001), the relevant EoP advisor accessed each participant's attendance log (stored at the leisure facility). He or she was asked to rate, on a 1–5 scale, the participant's adherence to the scheme (1 = dropped out during first month, 2 = dropped out during second month, 3 = dropped out during third month, 4 = still exercising at 3 months but not in accordance with prescription, and 5 = still exercising at 3 months in accordance with prescription; please note, a individual was defined as having 'dropped out' if he/she had stopped participating in their prescribed activities at their exercise referral site/facility).[2] This ordinal scale methodology, which was deemed to be relatively simple and straightforward for the EoP advisors to use, allowed us to distinguish between those who dropped out at different phases of the programme.

Measures

Perceived autonomy support (PAS)

Perceptions of the autonomy support provided by the EoP advisor were measured using a six-item version of the Health Care Climate Questionnaire (e.g., "My exercise on prescription advisor provided me with choices and options about how to exercise regularly"; Williams et al.,

[2]We also ran a series of models to discern whether those individuals who adhered for 3-months and exercised in accordance to their prescriptions (coded as 1; 51% of the sample) differed to the rest of the sample (coded as 0) in terms of the reported means of all variables at 3-months and the rate of change of these variables over time. The results obtained were analogous to those reported for Model c in the results.

1996). This scale has been shown to have a cronbach alpha of .95 in previous research (Williams et al., 1996).[3]

Psychological need satisfaction

Psychological need satisfaction was measured via a nine-item scale developed by Tobin (2003). Following the stem "Considering how you feel about exercise", participants responded to items tapping autonomy (e.g., "I exercise because I like to rather than because I feel I have to"), relatedness (e.g., "In exercise situations I feel supported") and competence (e.g., "I think I am pretty good at the exercise that I do") need satisfaction. Alpha values of .65, .81 and .80, for autonomy, relatedness and competence, have been reported (Tobin, 2003). Previous research has shown scale items to demonstrate a mean factor loading of .70 (Tobin, 2003), whilst confirmatory factor analysis revealed that all fit indices were acceptable (Tobin, 2003).

Motivational regulations for exercise

Participants' motivation to engage in exercise was measured using the 19-item Behavioural Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004). Using a 0–4 scale (0 = not true for me, 4 = very true for me), separate subscales of the BREQ-2 tap amotivation (e.g., "I don't see the point in exercising"), external (e.g., "I exercise because other people have said I should"), introjected (e.g., "I feel guilty when I do not exercise") and identified (e.g., "I value the benefits of exercise") regulation, as well as intrinsic motivation (e.g., "I exercise because it is fun"). Cronbach's alpha values for all BREQ-2 subscales have been shown to exceed .75 (Wilson & Rodgers, 2004).

Previous SDT-focused exercise research has typically neglected to measure or examine the role of integrated regulation (e.g., Wilson & Rodgers, 2004; Wilson et al., 2002, 2003). Therefore, to provide a more comprehensive assessment of all of the motivational regulations embedded with SDT (Deci & Ryan, 1985), participants also completed the four-item integrated regulation subscale of Li's (1999) Exercise Motivation Scale (e.g., "I exercise because it is consistent with what I value"). Using a 1–7 response format, this measure has been found to exhibit cronbach alpha values exceeding .75 (Li, 1999). To provide consistency in the response scales used across the assessments of the different motivational regulations, the 7-point scale utilized by Li (1999) was altered to correspond to the 0–4 scale employed in the BREQ-2.

Exercise behaviour

To measure levels of self-reported exercise behaviour and physical activity, participants completed the Godin Leisure-Time Exercise Questionnaire (GLTEQ; Godin & Shepard, 1985). The GLTEQ contains three questions assessing the frequency of mild (e.g., "easy walking"), moderate (e.g., "easy swimming") and strenuous (e.g., "running/jogging") exercise engaged in, for a minimum of 15 min, during a typical week. Based on its correlations with objective indicators of exercise and physical fitness (e.g., exercise monitor and maximal aerobic capacity test scores) previous research has concluded that the GLTEQ is a reliable and valid measure of leisure time exercise behaviour (Jacobs, Ainsworth, Hartman, & Leon, 1993).

[3]The range of scores for all the scales used in this study can be found in Table 1.

Barriers self-efficacy

Self-efficacy towards exercise engagement when presented with different barriers was measured using the 12-item Barriers-Efficacy Scale (McAuley & Mihalko, 1998). This scale assesses an individual's efficacy expectations regarding his or her capacity to exercise in the face of obstacles (e.g., bad weather, boredom). Cronbach alpha values of .85 have been reported in past research (McAuley & Mihalko, 1998).

Commitment

Commitment to the exercise prescription was measured with the four-item commitment subscale of Scanlan, Carpenter, Schmidt, Simons, and Keeler's (1993) Athletes' Opinion Survey which was adapted to refer to the exercise scheme (e.g., How determined are you to keep taking part in your exercise prescription). At the Time 3 assessment, the items were amended to assess participants' commitment to continue partaking in the types of exercise prescribed once their formal 3-month exercise prescription had been completed. In previous research a cronbach alpha of .85 has been revealed for this scale (Scanlan et al., 1993).

Behavioural intention

Behavioural intention to exercise, in general in one's life, was assessed via a three-item measure utilized by Wilson and Rodgers (2004). Items reflect both general (e.g., "I intend to exercise regularly during the next 3-months") and specific (e.g., "I intend to exercise at least 3 times per week during the next 3-months") exercise intentions. Previous research has reported an internal consistency of .89 for this scale (Wilson & Rodgers, 2004).

Positive and negative affect

The 20-item Positive Affect/Negative Affect Scale (PANAS; Watson, Tellegen, & Clark, 1988) was used to measure the degree of positive (e.g., "interested", "strong") and negative (e.g., "distressed", "upset") affect participants experienced in their lives. Watson et al. (1988) have shown the PANAS subscales to possess cronbach alpha values of .86 to .90.

Subjective vitality

The degree of subjective vitality that participants were experiencing in their lives was measured using the six-item state version of Ryan and Frederick's (1997) Subjective Vitality Scale (e.g., "Over the past week or so I felt energised"). This scale has been shown to possess cronbach alpha values exceeding .80 (Bostic, Rubio, & Hood, 2000).

Satisfaction with life

Satisfaction with life was measured via the five-item Satisfaction with Life Scale (e.g., "In most ways my life is close to ideal"; Diener et al., 1985). Cronbach alpha coefficients exceeding .80 have been reported for this scale (Diener et al., 1985; Pavot & Diener, 1993).

Table 1
Reliability analyses (Cronbach's coefficient α) and descriptive statistics for perceived autonomy support (PAS), psychological need satisfaction, motivational regulations, exercise-related behavioural and cognitive outcomes, and indices of well-being

	Range	Baseline			1-month post-entry			3-month post-entry		
		α	*M*	SD	α	*M*	SD	α	*M*	SD
PAS	1–7	.91	5.81	1.17	.91	5.36	1.32	.95	4.96	1.66
Autonomy	1–7	.59	4.01	1.62	.62	4.15	1.53	.55	4.05	1.58
Relatedness	1–7	.88	3.50	1.69	.74	3.73	1.45	.77	3.37	1.32
Competence	1–7	.78	3.35	1.69	.83	3.82	1.34	.72	3.66	1.05
Amotivation	0–4	.88	0.41	0.82	.72	0.41	0.62	.76	0.31	0.51
External regulation	0–4	.74	1.03	0.97	.81	1.30	1.05	.79	0.83	0.89
Introjected regulation	0–4	.84	1.63	1.23	.81	2.29	1.11	.84	2.01	1.04
Identified regulation	0–4	.79	3.06	0.85	.74	2.74	0.80	.85	2.41	0.88
Integrated regulation	0–4	.70	2.27	0.95	.86	2.41	1.06	.87	2.01	1.10
Intrinsic motivation	0–4	.91	2.22	1.11	.90	2.48	1.05	.98	2.23	0.96
Total exercise	0–79	—	20.47	18.99	0–98	38.44	24.26	5–84	30.74	19.94
Self-efficacy	0–100	.89	52.84	20.40	.92	53.11	23.07	.88	47.56	20.10
Commitment	1–5	—	—	—	.76	4.07	0.78	.82	3.59	0.97
Behavioural intention	1–7	—	—	—	.78	5.61	1.33	.91	5.08	1.59
Positive affect	1–5	.92	3.35	0.94	.94	3.01	1.00	.89	1.44	0.43
Negative affect	1–5	.73	2.15	0.75	.88	2.21	1.04	.80	1.14	0.42
Subjective vitality	1–7	.89	3.35	1.73	.88	3.27	1.50	.91	2.99	1.50
Satisfaction with life	1–7	.96	3.45	1.62	.94	3.34	1.51	.95	3.54	1.63

Note: No α values are provided for total exercise as this represents a global score calculated from the multiplicative function of three weighted items. Commitment and behavioural intention were not measured at baseline.

Results

Reliability analyses, descriptive statistics and Pearson's correlations

Internal consistency estimates (Cronbach alphas) and descriptive statistics were computed for all variables at each relevant measurement point (i.e., baseline, and/or 1- and 3-months; Table 1). The alpha values observed for autonomy need satisfaction, on all three measurement occasions, were marginal, and thus, results pertaining to this variable should be interpreted with some caution.

Twenty six and a half percent of participants dropped out of their exercise prescription during the first month (i.e., stopped participating in their prescribed activities at their exercise referral site/facility), 18.4% dropped out during the second month, 4.1% were still exercising at the end of the 3-months but did not exercise in accordance with the amount of exercise prescribed, and 51% were still exercising at the end of the 3-months in accordance with their prescriptions. At 1-month and 3-months post-entry to the scheme, 27% and 30%, respectively, of those who sent back their questionnaires, had dropped out of their exercise prescription programme.

A paired samples *t*-test revealed that those participants who returned their questionnaires at 3-months post-entry to the scheme reported a significant ($t(26) = 4.47$, $p \leqslant .001$) decrease in their

weight between entry to the scheme ($M = 101.05$, $SD = 18.41$) and the end of the exercise prescription ($M = 97.78$, $SD = 18.15$). The η^2 statistic (.04) indicated a small effect size for weight loss.

Pearson's correlations were computed between each study variable at baseline, 1- and 3-months. The magnitude of the relationship between each of the study variables varied over the three measurement occasions, but generally, positive correlations were observed between PAS and the psychological needs, and between the psychological needs and self-determined forms of motivational regulation. Moreover, psychological need satisfaction and self-determined motivational regulations tended to be positively correlated with positive behavioural, cognitive and affective outcomes, and negatively correlated with negative affect.[4]

Multilevel regression analyses

Following the procedures and guidelines outlined by Singer and Willett (2003), multilevel regression analyses (MLA), using MLwin (version 2.0; Rasbash, Steele, Browne, & Prosser, 2005), were used to test the main hypotheses. As with standard regression analyses, the aim of MLA is to express the dependent variable as a function of predictor variables. However, the multilevel regression equations specified in this study incorporated two levels of analyses: A within-person equation (or Level 1 model), which is concerned with within-individual change (i.e., how each individual changes over time), and a between-person equation (or Level 2 model), which is concerned with inter-individual differences in change (i.e., what predicts differences between people in their rate of change).

MLA was chosen as it is particularly useful for the analysis of longitudinal data in which there are several measurements nested within individuals. In this study, the data set was comprised of three observations (baseline, 1- and 3-months, with the exception of commitment and behavioural intention which were not assessed at baseline) nested within individuals. MLA is also suitable when there are missing data (i.e., participants not completing all assessments), as was the case in the present study (see Singer & Willett, 2003, for more information).

Data analysis and model testing

A series of models addressed the main aims of the current study. For PAS, four models are presented (i.e., a–d, described below). For all other variables, five models are presented (i.e., a–e, described below). Model (a) represents a conditional means model with time centred at baseline and adherence as the predictor (see Procedures section for the coding of this variable). This model examines differences between those who adhered more, versus less, in baseline levels of each study variable. Essentially, Model (a) determines whether we need to control for baseline differences in subsequent analyses. In Models b–e, time was centred at 3-months [as opposed to baseline as in Model (a)], thus, allowing for the examination of differences in the study variables at the end of the 3-month exercise prescription. Model (b) represents an unconditional (i.e., no predictors) growth model examining the intercept and rate of change of each study variable for the sample as a whole. Model (c) constitutes

[4] A Table of all correlations is available from the first author on request.

a conditional growth model, with adherence as a predictor, estimating differences between those who adhered more and those who adhered less on each study variable at 3-months, as well as the rate of change of these variables over time. Given the impact of age and gender on exercise engagement (e.g., Department of Health, 2004; US Department of Health and Human Services, 1996), Model (d) represents a conditional growth model estimating the main effects of these two demographic variables on each outcome, as well as their interaction effects with time, in order to ascertain whether their effects vary with across the programme. Finally, Model (e) represents a conditional growth model estimating the main effects of key psychological variables proposed by SDT to predict each psychological need, motivational regulation and motivation-related outcome. The interaction effects of these key variables with time were also calculated. In each of the aforementioned conditional models, except in Model (b), we controlled for adherence, as this represents the key variable of interest in the current study.

Preliminary data analysis

Inspecting the normality of the data (i.e., via skewness and kurtosis values and the Kolmogorov–Smirnov statistic) revealed that the data were normally distributed in the majority of instances. Only for relatedness need satisfaction at 1-month did a significant Kolmogorov–Smirnov statistic emerge ($p = .00$; skewness = .37, kurtosis = $-.10$). Moreover, inspection of the scatterplots and the normality probability plots of the regression standardized residuals suggested that the assumptions of normality, linearity, homoscedasticity and independence of residuals were met. A mean intraclass correlation of .49 was observed for the variables under investigation (min = .20, max = .86), justifying the use of multilevel modelling.

Baseline differences controlling for adherence (Model a)

Participants who adhered more to their 3-month prescriptions did not report significantly different baseline levels of any of the study variables, compared to those who adhered less. Thus, subsequent models did not need to control for baseline scores when examining differences at the end of the 3-month scheme.[5]

Mean scores at 3-months and rates of change for the sample as a whole (Model b)

For the total sample, the mean level (i.e., intercept) of each study variable was significantly different from zero at the end of the 3-month scheme. Examining the slopes of all variables revealed that PAS ($B = -0.37$, $p < .01$), identified regulation ($B = -0.33$, $p < .001$), commitment ($B = -0.53$, $p < .01$), behavioural intention ($B = -6.53$, $p < .05$) positive affect ($B = -.92$, $p < .001$) and negative affect ($B = -0.47$, $p < .001$) decreased over the 3-month (2-month for commitment and behavioural intention) exercise prescription period. Total exercise ($B = 7.17$, $p < .001$) and introjected regulation ($B = .29$, $p < .01$) increased with time.

[5]Tables including data from all the MLA analyses are available from the first author on request.

Mean differences at 3-months and rates of change controlling for adherence (Model c)

At the end of the 3-month exercise referral, those individuals who adhered more reported greater self-efficacy to overcome barriers to exercise compared to those who adhered less ($B = 3.23$, $p < .05$), an effect which decreased over time ($B = -2.46$, $p < .05$). There were no differences in any of the other variables reported at 3-months. One other significant interaction emerged between relatedness and time ($B = 0.21$, $p < .05$). Plotting this interaction revealed that adherence was not a significant predictor of relatedness at baseline, but its effect did become significant at 1- and 3-months. This effect increased between 1- and 3-months showing that those who adhered more reported a greater increase in relatedness over time.

Examining the effects of age and gender (Model d)

Age was a negative predictor of total exercise ($B = -0.68$, $p < .05$). Gender (0 = male, 1 = female) approached significance as a positive predictor of commitment ($B = 0.65$, $p = .054$). The interaction between gender and time ($B = 0.51$, $p < .05$) was a significant predictor of relatedness need satisfaction. This demonstrates that women reported a greater increase in relatedness over the course of the exercise prescription, compared to men. No other main effects or interaction effects between age, gender and time were observed. Due to convergence problems, a consequence of the number of predictors included in Model (e), age and gender were removed from subsequent models.

Predicting need satisfaction, motivational regulations and behavioural, cognitive and affective outcomes (Model e)

Next, we examined the predictive effect of PAS on the satisfaction of the three basic psychological needs, PAS and psychological need satisfaction on each of the motivational regulations, and PAS, psychological need satisfaction and the motivational regulations on exercise-related outcomes and the indicators of well-being.

Autonomy was a negative ($B = -0.34$, $p < .001$) predictor of external regulation and a positive predictor of identified ($B = 0.21$, $p < .05$) and integrated regulations ($B = 0.34$, $p < .001$) and intrinsic motivation ($B = 0.32$, $p < .001$). The three most self-determined forms of exercise motivation were also predicted by the interaction between time and autonomy (identified $B = 0.15$, $p < .01$; integrated $B = 0.19$, $p < .001$; intrinsic $B = 0.10$, $p < .05$). Plotting these interactions revealed the effect of autonomy on identified and integrated regulation and intrinsic motivation increased with time. Intrinsic motivation was also predicted by the interaction between competence and time ($B = 0.18$, $p < .01$). The plot of this interaction indicated that the effect of competence increased over time.

With regard to the exercise-related behavioural and cognitive outcomes, integrated ($B = 17.84$, $p < .01$) and introjected ($B = 11.41$, $p < .05$) regulations emerged as positive predictors, and identified regulation as a negative predictor ($B = -28.16$, $p < .01$) of total exercise. Integrated regulation emerged as a positive predictor of barrier self-efficacy ($B = 18.53$, $p < .01$), the effect of which became significantly more positive over time ($B = 9.66$, $p < .05$). With regard to commitment to exercise, external regulation emerged as a negative predictor ($B = -0.70$,

$p<.01$), an effect which increased over time ($B=-0.76$, $p<.01$). Competence ($B=0.37$, $p<.05$), integrated regulation ($B=0.74$, $p<.05$) and intrinsic motivation ($B=0.66$, $p<.01$) emerged as positive predictors of commitment. Competence ($B=0.59$, $p<.05$), integrated regulation ($B=1.78$, $p<.001$), as well as intrinsic motivation ($B=1.54$, $p<.001$), emerged as positive predictors of behavioural intention to continue exercising. The effects of all three predictors increased with time (competence $B=0.53$, $p<.05$; integrated $B=1.40$, $p<.001$; intrinsic $B=1.38$, $p<.001$).

Finally, considering the well-being outcomes, intrinsic motivation emerged as a positive predictor ($B=0.36$, $p<.05$) of general positive affect. Introjected regulation emerged as a negative predictor of subjective vitality ($B=-0.81$, $p<.05$). Moreover, autonomy need satisfaction derived from exercise emerged as a positive predictor of satisfaction with life ($B=0.36$, $p<.05$), the effect of which increased over time ($B=0.20$, $p<.05$).[6]

Discussion

Grounded in SDT (Deci & Ryan, 1985), this study aimed to delineate the motivational processes pertinent to exercise engagement, exercise-related cognitions, and indices of well-being among overweight/obese patients referred by their doctor to an EoP scheme to facilitate weight loss. Specifically, we examined whether those individuals who adhered more to their exercise prescriptions differed from those who exercised less on a number of variables upon exiting the 3-month scheme; namely, perceived autonomy support, psychological need satisfaction, self-determined and controlled motivation, general exercise behaviour, self-efficacy to overcome barriers to exercise, commitment to the exercise prescription, behavioural intention regarding exercise involvement in the future, and indicators of general well-being. We also determined the rate of change of each of the study variables over the course of the programme for the whole sample, and differences in these rates between those who adhered more and those who exhibited lower adherence. In addition, we examined the motivational sequence embedded in SDT by testing autonomy support as a predictor of need satisfaction, autonomy support and need satisfaction as predictors of the motivational regulations, and autonomy support, need satisfaction and the motivational regulations as predictors of behavioural, cognitive and well-being outcomes.

At baseline, there was no difference between those who adhered more, versus less, in any of the study variables. Thus, any differences observed at the end of the study between exercisers with different degrees of adherence could not be attributed to differences reported at baseline.

Perceived autonomy support, identified regulation, commitment, behavioural intention and positive and negative affect were observed to decrease over the course of the 3-month exercise prescription for the sample as a whole. Total exercise and introjected regulation increased with time.

[6]In line with the theoretical propositions of Vallerand (1997) we also examined the mediating role of the psychological needs in the relationship between autonomy support and the motivational regulations, and the mediating role of the motivational regulations in the relationships between psychological need satisfaction and the behavioural cognitive and well-being outcomes. In no instance were the conditions for mediation outlined by Krull and MacKinnon (2001) satisfied.

Considering the structure of the EoP scheme from which participants were recruited may help us explicate the observed decrease in autonomy support reported over the course of the exercise prescription. Within their first month in the scheme, participants received an initial consultation with the EoP advisor to discuss their physical status/exercise requirements. They also were involved in an exercise induction session, in which they were shown how to use the exercise equipment and perform the exercises prescribed. Although some support was offered in the weeks following these sessions, the EoP advisors then focused their time and attention upon new referrals. Thus, subsequent interactions between the advisors and participants may have proved insufficient in quantity (and perhaps quality) to maintain the level of perceived autonomy support experienced during the initial weeks of the scheme. This suggests that, for people with little or no prior experience of exercise schemes, withdrawal of contact should be a gradual process and efforts should be made to keep the provision of autonomy support in tact. In considering this suggestion, it is important that the construct of autonomy is not confused with that of independence (Deci & Ryan, 2000).

With respect to the observed decrease in identified regulation, one should keep in mind that this motivational regulation reflects the degree to which an individual values the outcomes associated with a specified behaviour. To value the outcomes associated with exercise, it seems reasonable to assume that an individual would need to understand the benefits of regular engagement in exercise. Participants were typically sedentary upon entering the EoP scheme. Consequently, their knowledge of the positive consequences of exercise was probably limited. During the first month in the scheme, participants were educated by their doctor, and then by their EoP advisor, about the advantages of maintained exercise participation. However, when this contact was reduced, these beneficial effects may have become less apparent. Linked to this, given that participants had been exercising for only a short period of time, it was also unlikely that they would have begun to derive any of the physical and psychological benefits associated with exercise, and thus, have started to observe these benefits first hand. It is also possible that the observed reduction in identified regulation was a consequence of participants' having unrealistic expectations about the extent to which exercise could facilitate weight loss in the short term. Weight loss is (or should be) gradual, and, in the absence of any immediate success, participants may have begun to question the value of exercise in facilitating this process.

It is also notable that introjected regulation increased over the course of the exercise prescription. It is possible that this temporal patterning was linked to the aforementioned decrease in identified regulation. If an individual is not reminded about the benefits of exercise or does not see how the activity is benefiting them personally they may begin to question or doubt the utility of this activity. Consequently, more external forms of regulation may begin to guide behaviour (i.e., in opposition to the desired internalization process). Thus, given that the study participants had been told they must exercise to improve their health and reduce their risk of disease, an internal sense of obligation to exercise may have begun to dominate the regulation of their exercise behaviour.

The observed decrease in commitment and behavioural intention to exercise may reflect a realization among participants of how difficult it is to maintain regular exercise behaviour, especially once the initial support of the doctor and EoP advisor is taken away. It is interesting to note that competence need satisfaction, integrated regulation and intrinsic motivation emerged as positive predictors of both of these cognitive outcomes. External regulation also emerged as

a negative predictor of commitment. This suggests that to increase individuals' commitment to the EoP scheme, as well as their behavioural intention to exercise in general, EoP advisors should continually attempt to foster competence need satisfaction and facilitate the internalization process so that the most self-determined forms of regulation guide behaviour.

Those individuals who demonstrated greater adherence to the scheme reported greater barrier efficacy than those who adhered less. This finding supports and extends previous cross-sectional (e.g., Sallis, Pinski, Grossman, Patterson, & Nader, 1988) and prospective (e.g., McAuley, 1993; Sallis, Hovell, Hofstetter, & Barrington, 1992) research, which has consistently shown that barrier efficacy is related to exercise adherence. As mentioned previously, competence need satisfaction also emerged as a positive predictor of commitment to the EoP scheme. Collectively, these findings highlight the importance of feelings of efficaciousness within the physical domain (Sallis & Owen, 1998).

Results also showed that those who adhered more to the scheme demonstrated a significant positive linear rate of change in relatedness need satisfaction, compared to those who adhered less. Previous studies in the exercise domain have pointed to the salience of the need for relatedness to the adoption of more self-determined motivational regulations for exercise (Edmunds et al., 2005). However, to our knowledge, this is the first study to find relatedness need satisfaction as a predictor of behavioural persistence with respect to exercise engagement.

The work of Noar and Zimmerman (2005) seems pertinent to the observed link between relatedness need satisfaction and exercise behaviour. These authors suggest that the theoretical constructs relevant to the continuance of behaviour change may be distinct from those that are relevant to the initiation of behaviour change. To date, the majority of SDT-grounded studies of exercise engagement have utilized physically active participants (e.g., Edmunds et al., 2005; Edmunds et al., 2006; Wilson & Rodgers, 2002, 2004; Wilson et al., 2002). Such research may well have tapped the processes underpinning the long-term maintenance of exercise behaviour. The present findings, however, provide evidence for the relevance of the relatedness need in the initial stages of exercise adoption. Further studies are needed to delineate the relevance of relatedness, as well as the other two basic needs, at different stages of change for exercise behaviour (e.g., pre-contemplation, contemplation, preparation, action and maintenance), as well as in terms of progressions from one stage to the next.

In explicating the relatedness behavioural engagement link, it could be assumed that feelings of connectivity and support gleaned from other participants became progressively more important over time as autonomy support from the EoP advisor decreased. This suggests that when exercise advisors/instructors are unable to provide regular support and guidance to exercise participants, because of time constraints for example, it may be important to encourage individuals in the exercise setting to interact with one another.

In predicting need satisfaction, motivational regulations, and the targeted behavioural, cognitive and affective outcomes within the exercise domain, the results of the MLA were, in most instances, aligned with the propositions of SDT. Autonomy need satisfaction emerged as a negative predictor of external regulation, but positively predicted self-determined motivation. Competence also positively predicted intrinsic motivation. These findings suggest that for overweight/obese individuals, feelings of choice and volition about what types of activity are engaged in, as well as perceptions of competence that they can effectively perform the chosen activities, are important to the development of self-determined motivation towards exercise.

The results also indicated that the two most self-determined forms of motivation were pertinent to the prediction of overall (self-reported) levels of exercise behaviour, commitment to the exercise prescription, behavioural intention to continue exercising in one's general life, and self-efficacy to overcome barriers to exercise. Recent cross-sectional studies have revealed identified and integrated regulation and intrinsic motivation as positive predictors of desirable cognitive and affective responses to exercise (e.g., Edmunds et al., 2005; Edmunds et al., 2006). Via the employment of a longitudinal methodology, the current study further underlines the relevance of self-determined motivation to the promotion of beneficial outcomes in the exercise domain (Pelletier et al., 2001; Perrin, 1979; Wilson et al., 2003).

The findings of this longitudinal study also support SDT and the basic needs theory (Deci & Ryan, 1985; Ryan & Deci, 2000) claims that a psychological need is an energizing state which, if satisfied, will be conducive towards optimal health and well-being. Exercise-related autonomy positively predicted satisfaction with life. Moreover, intrinsic motivation emerged as a positive predictor of positive affect and introjected regulation was found to be a negative predictor of subjective vitality. These findings suggest that when individuals feel self-determined with regard to exercise, enhanced well-being can be experienced beyond the exercise context per se. That is, self-determined exercise engagement might play a role in the global satisfaction and general affective responses of the exerciser.

Not all of the findings stemming from the MLA were consistent with the assumptions of SDT however. Notably, introjected regulation emerged as a positive, and identified regulation as a negative, predictor of total exercise. To provide more insight into this finding, we examined the bivariate correlations between adherence and introjected and identified regulations on each measurement occasion. Inspecting these correlations revealed that introjected regulation was actually negatively related to adherence at baseline, 1-month and 3-months, whilst identified regulation was positively correlated to adherence on each measurement occasion. Thus, the findings observed in the multilevel model involving these two variables should be ignored as they are a consequence of net suppression (Cohen & Cohen, 1983).

Limitations

When discussing the present findings, a number of study limitations appear worthy of discussion. For example, the majority of participants were white females. Before generalizing from the current results, in the writing of guidelines for EoP advisors for example, future studies which include a higher percentage of men and minority ethnic groups are warranted. We should also highlight the fact that participants were asked to rate their advisor's autonomy support without actually partaking in any exercise session with him/her (i.e., participants had only taken part in a consultation session to discuss their referral, health status and prescription). It may have been better to assess autonomy support at the end of the first session. It is also notable that those participants that adhered more to their exercise prescriptions did not report greater overall engagement in exercise over the course of the 3-month scheme, compared to those who adhered less. It is possible that participants who adhered less over-reported their exercise participation, as they may have been embarrassed about their lack of success. To overcome this possibility, future exercise research grounded in SDT should consider utilizing objective measures of exercise. With respect to the need for obtaining more objective marker of exercise behaviour in subsequent work,

we also need to keep in mind that the use of attendance records in the current study did not provide an indication of the intensity of exercise engaged in. The use of objective measures would also help to rectify this shortcoming. This suggestion regarding the use of objective measures also extends to measures of weight, or more specifically, weight loss.

Conclusions

With the exception of relatedness need satisfaction, the results of the current investigation suggest that those individuals who adhered more, versus less, to EoP schemes do not report higher levels of perceived autonomy support, psychological need satisfaction or self-determined motivation on completion of the prescription. As a potential consequence, those who adhered more did not report greater levels of exercise behaviour, certain exercise related cognitions, or general well-being. Nonetheless, the psychological needs embedded in SDT were observed to underpin self-determined regulation, which collectively, predicted adaptive outcomes. Consequently, these findings suggest that to increase their success, there is a need to consider motivationally embellished EoP schemes that pull from the tenets of SDT and aim to foster participants' basic psychological need satisfaction and self-determined motivational regulation.

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