Journal of Sport & Exercise Psychology, 2016, 38, 567-578
https://doi.org/10.1123/jsep.2016-0146

Human Kinetics
ORIGINAL RESEARCH

An Exercise in Resistance: Inoculation Messaging as a Strategy for Protecting Motivation During a Monotonous and Controlling Exercise Class

James A. Dimmock,[1] Marylène Gagné,[1] Lauren Proud,[1] Timothy C. Howle,[1] Amanda L. Rebar,[2] and Ben Jackson[1]

[1]The University of Western Australia; [2]Central Queensland University

Sustained attention has been devoted to studying the factors that support (or thwart) individuals' enjoyment of, interest in, and value judgments regarding their exercise activities. We employed a resistance-inducing (i.e., inoculation theory) messaging technique with the aim of protecting these desirable perceptions in the face of environmental conditions designed to undermine one's positive exercise experiences. Autonomously motivated exercisers (N = 146, M_{age} = 20.57, SD = 4.02) performed a 25-min, group-based, instructor-led exercise circuit, in which the activities were deliberately monotonous, and during which the confederate instructor acted in a disinterested, unsupportive, and critical manner. Shortly before the session, participants received either a control message containing general information about the exercise class or an inoculation message containing a forewarning about potential challenges to participants' enjoyment/interest/value perceptions during the class, as well as information about how participants might maintain positive perceptions in the face of these challenges. Despite there being no between-conditions differences in presession mood or general exercise motives, inoculated (relative to control) participants reported greater interest/enjoyment in the exercise session and higher perceptions of need support from the instructor. Perceptions of need support mediated the relationship between message condition and interest/enjoyment.

Keywords: autonomous, enjoyment, persuasion, physical activity, resilience, thwarting

An abundance of research aligned with self-determination theory (SDT; Deci & Ryan, 1985) indicates that self-determined motivation for exercise (i.e., the pursuit of exercise due to self-endorsed, volitional reasons) is positively associated with a variety of adaptive outcomes, including exercise engagement and adherence (e.g., Chatzisarantis, Hagger, Biddle, Smith, & Wang, 2003; Vansteenkiste, Simons, Soenens, & Lens, 2004), physical self-esteem (Wilson & Rodgers, 2002), positive affect (e.g., Standage, Duda, & Ntoumanis, 2005), and quality of life (Gillison, Standage, & Skevington, 2006). Self-determined motivation is supported when psychological needs for autonomy (i.e., feeling that we initiate our decisions and that our behaviors reflect our aims and choices), competence (i.e., feeling proficient to successfully carry out pursuits), and relatedness (i.e., feeling that one is understood by, cared for, and connected to important others) are satisfied, and social conditions are instrumental in determining the extent of need satisfaction (Deci & Ryan, 1985). For instance, conditions such as the provision of choice and rationales (i.e., autonomy support), goals and feedback (i.e., competence support), and warmth and caring (i.e., relatedness support) have been shown to be influential in promoting self-determined exercise motivation via their effects on need satisfaction (Edmunds, Ntoumanis, & Duda, 2006; Markland & Tobin, 2010; Mouratidis, Vansteenkiste, Lens, & Sideridis, 2008; Tessier, Sarrazin, & Ntoumanis, 2010).

Unfortunately, over the course of time, as well as experiencing need-supportive conditions, individuals may also encounter situations in which their basic psychological needs are left unsatisfied or undermined. Research has shown that instances in which needs are actively undermined (i.e., need thwarting) are associated with negative outcomes, such as compromised relational functioning (e.g., Costa, Ntoumanis, & Bartholomew,

James A. Dimmock, Timothy C. Howle, and Ben Jackson are with the School of Human Sciences, The University of Western Australia, Perth, Western Australia, Australia. Marylene Gagne is with the School of Business, The University of Western Australia, Perth, Western Australia, Australia. Lauren Proud is with the School of Psychology, The University of Western Australia, Perth, Western Australia, Australia. Amanda L. Rebar is with the School of Human, Health and Social Sciences, Central Queensland University. Address author correspondence to James Dimmock at james.dimmock@uwa.edu.au.

2015) and negative affect (Bartholomew, Ntoumanis, Ryan, Bosch, & Thogersen-Ntoumani, 2011). Negative outcomes have also been associated with an absence of need support (i.e., need depriving; e.g., Hodge, Lonsdale, & Ng, 2008), indicating that psychological growth and healthy functioning are contingent on the experience of supportive conditions rather than the mere absence of unsupportive conditions (see Vansteenkiste & Ryan, 2013). To illustrate the relative effects of need support, need depriving, and need thwarting, Vansteenkiste and Ryan (2013) indicated that just as plants need nutrients to grow (i.e., water, sunshine), humans require satisfaction of basic psychological needs for psychological thriving. In the absence of need support (i.e., need depriving), psychological costs will be experienced in much the same way as if plants are deprived of nutrients, and if needs are actively thwarted (i.e., synonymous with plants given salted water), the deteriorating process will be accelerated.

A major tenet in SDT is that if need satisfaction is not experienced, the processes required to maintain or enhance self-determined forms of motivation are not catalyzed (Deci & Ryan, 2000). Instead, in circumstances in which psychological needs are deprived or thwarted, individuals are likely to develop controlled forms of motivation or amotivation (e.g., De Meyer et al., 2014; but see Ng et al., 2012, for the effect of need deprivation on controlled motivation). To protect and enhance self-determined forms of motivation in exercise, then, efforts are needed to (a) ensure that exercisers are mostly exposed to need-supportive conditions rather than need-thwarting or need-depriving conditions and (b) provide exercisers with strategies to cope with need-thwarting or need-depriving environments when they do encounter them (to minimize their relatively deleterious consequences). In relation to this latter point, it is noteworthy that some individuals are better equipped for dealing with challenging environments than others (Vansteenkiste & Ryan, 2013). These individual differences in resilience are associated with differing capacities for mindfulness and autonomous functioning and are built slowly over time (Vansteenkiste & Ryan, 2013). More specifically, through exposure to differing caregiving practices, individuals grow to develop different tendencies to interact with the environment using open, unbiased perception and responding. In the face of stressful stimuli, resilient individuals display a reduced threat response and interact more adaptively than those low in resilience (Hodgins et al., 2010; Mask & Blanchard, 2011).

Despite improvements in our understanding of resilience as a stable individual difference construct, much is still to be learned about whether short-term strategies or acute treatments can be used to help individuals cope with or reinterpret events in which their needs are not supported. In the current study, we explore the possibility that a short-term preventive strategy can help autonomously motivated exercisers cope with (i.e., protect their motivation in) an exercise environment that is unsupportive of their psychological needs. We use inoculation theory (McGuire, 1961a, 1961b)—a popular theory on attitudinal resistance—as a framework to understand and develop resistance in exercisers' self-determined motivation. Inoculation theory is regarded as the grandparent theory of resistance to change (Eagly & Chaiken, 1993), yet its tenets have never been tested in relation to resistance against motivationally challenging conditions as discussed in SDT.

Inoculation Theory: A Framework for Protecting Autonomous Motivation in Exercise?

In inoculation theory, McGuire (1964) suggests that attitudes can be inoculated against attacks in much the same way that one's immune system can be inoculated against viruses. In conventional medical immunization, weakened forms of viruses are injected into the body, and the body then reacts to this injection (e.g., through cell adaptation), protecting the body from future attacks from that virus. McGuire (1964) contended that by exposing individuals to a persuasive message that contains weakened arguments against an established attitude (e.g., a message that presents both counterarguments and refutations of those counterarguments), individuals will develop resistance against stronger, future persuasive attacks. Over the half-century since the development of inoculation theory, scores of studies serve as evidence that the central tenets of the theory hold up well to empirical scrutiny (Banas & Rains, 2010). Many inoculation theory researchers have focused on studying health-related perceptions (see Compton, Jackson, & Dimmock, 2016, for review), particularly in relation to attitudinal resistance. Recently, however, evidence has emerged to indicate that inoculation messaging can also protect constructs such as self-efficacy and affective states (Jackson, Compton, Thornton, & Dimmock, under review; Jackson, Compton, Whiddett, Anthony, & Dimmock, 2015). In light of these significant effects of inoculation messages on constructs other than attitudes, there is potential that inoculation treatments could protect against losses or challenges to self-determined motivation as well.

In relation to the aims of the current study, we sought to protect self-determined exercisers' positive experiences with exercise (i.e., perceptions of enjoyment, value/usefulness, and need support) despite being led by an unsupportive and critical exercise instructor. Before experiencing these challenging contextual conditions, participants were randomly assigned to a control group that received a neutral message or a treatment group that received an inoculation message. Consistent with most inoculation messages, our inoculation message included a forewarning that the reader's (favorable) perceptions of exercise might be challenged in an upcoming exercise class, material that highlighted example challenges that he or she could face (i.e., counterarguments), and information that could help the reader overcome those specific challenges (i.e., refutations). The counterarguments and

refutations provided in the inoculation message were focused on (a) perceptions of enjoyment in the upcoming exercise session, (b) perceptions of value/usefulness in the upcoming exercise session, and (c) perceptions of instructor-based need-supportive behavior in the upcoming exercise session. In light of previous literature on inoculation effects (Banas & Rains, 2010), we expected that the inclusion of these topics in our inoculation message would provide protection against challenges to self-determined motivation in the subsequent exercise session.

We hypothesized that self-determined exercisers who received an inoculation message, relative to those who received a control message, would report higher ratings of (a) value/usefulness, (b) interest/enjoyment, (c) positive instructor perceptions, and (d) perceived need support from the instructor, in relation to a class in which an exercise instructor provided unsupportive social conditions. Further, we hypothesized that the effects of message condition on value/usefulness and interest/enjoyment would be mediated by perceptions of need support from the instructor.

Method

Participants and Procedure

After receiving ethical approval for the study, we sought to recruit participants who were likely to derive at least some enjoyment and value from the exercise session, and so participants were recruited from an undergraduate kinesiology class at the lead author's institution. Participation was voluntary in return for course credit, and the final sample consisted of 146 undergraduates (M_{age} = 20.57, SD = 4.02) who were cluster randomized (by exercise class) into control (n = 74, M_{age} = 20.70, SD = 3.71, 40 male, 34 female) or treatment (n = 72, M_{age} = 20.43, SD = 4.34, 34 male, 38 female) conditions. Participants were informed that they would perform a 25-min group-based exercise circuit, consisting of rotations around five different exercise "stations." The decision to have all members of a given class in the same condition was made to avoid potential word-of-mouth contamination effects that may arise by having treatment and control participants in the same exercise class. Participants were randomly assigned to an exercise group consisting of approximately 15 members and were allocated a time to attend their exercise class. In an attempt to minimize suspicion as to the nature of the experiment, participants were informed that the purpose of the circuit was to test the dose–response relationship between exercise duration and mood, and that other participants would be completing sessions of different duration.

Upon arriving for their exercise class, participants were given an information sheet, were asked to complete an exercise readiness questionnaire, and provided their informed consent to complete the study protocol. Subsequently, all participants were presented with an information sheet that contained the control or treatment material (described in the following section). On the basis of their response to a screening question provided before the exercise circuit, all participants verified that they had read the information provided, and so all were suitable for use in subsequent analyses.

The exercise circuit consisted of five activity stations, including skipping rope, jumping low hurdles, passing basketballs, squatting while holding a medicine ball, and holding a bridge–plank position. These activities were chosen as they involved little (or no) interaction, were not complex to learn, and involved little progression, so that they would likely become repetitive and monotonous (e.g., Sylvester et al., 2016). Within each class, participants were assigned to one of five different groups rotating through the activities and were instructed that they should not interact with those whom they were performing alongside. Each group began at a different station, and after 45 s of engaging in the activity, participants had 15 s to move and ready themselves for the next station.

A male confederate instructor (who was unfamiliar to all participants, present for all sessions, and blind to condition) was trained to lead the exercise class in an unsupportive and controlling manner. The instructor avoided catering for autonomy by noting that questions would not be invited, telling participants that they "must" perform the activities and "follow the rules," providing no rationales in his instructions and acting in an authoritative manner. In relation to competence–structure, the instructor was told to not provide feedback or direction to participants about their performance. For example, if participants asked questions (e.g., "Am I doing this right?"), the instructor was told to respond without providing any corrective or positive feedback (e.g., "I'm not here to address questions—carry on"). Finally, with respect to relatedness, the instructor was asked not to introduce himself, smile, encourage, or initiate any one-on-one communication with students and was asked to request silence when he noticed participants talking with one another. The instructor was asked to behave consistently across all exercise classes and was observed for consistency during all classes by one of the authors. Immediately before and after the exercise circuit, participants were asked to complete a series of questionnaires designed to assess a range of class-, inoculation-, and instructor-related variables (see the Measures section).

Experimental Manipulation

Participants in the control condition received a generic one-paragraph information sheet that simply detailed the requirements and (bogus) purpose of the exercise class (see Appendix A). For those in the treatment condition, however, this generic information preceded additional material developed using inoculation theory principles. Specifically, participants were first provided with a forewarning that any positive thoughts they may typically have about exercise may be challenged in this circuit class (see Appendix B). Following this forewarning, participants receiving the inoculation treatment were presented with three counterarguments and paired

(i.e., passive) refutations that targeted (and refuted) the challenges that they were likely to face in the ensuing exercise class. The first counterargument–refutation pairing was designed to highlight and address the potential that participants may—at some point during the class—begin to question the benefits–value of the circuit (see Appendix B) and focused specifically on reassuring individuals regarding the benefits that can be derived from the kinds of activities being performed. The second pairing focused on highlighting the potential challenges to participants' enjoyment and interest (i.e., in the form of experiencing boredom) and provided information that may enable participants to retain their enjoyment–interest should these perceptions be challenged. The final pairing focused on drawing participants' attention to (and subsequently minimizing concerns regarding) any unsupportive behavior that the instructor might display during the session.

Measures

Background Variables and Manipulation Checks.

Exercise Motivation. Before the class, participants' motivation for exercise was measured using the Behavioral Regulation in Exercise Questionnaire-2 (BREQ-2; Markland & Tobin, 2004). Participants were asked to reflect on their reasons for engaging in exercise, and using a 5-point response scale anchored at 0 (*not at all true for me*) and 4 (*very true for me*), responded to items assessing amotivation (four items, e.g., "I think exercising is a waste of time"), external regulation (four items, e.g., "I exercise because other people say I should"), introjected regulation (three items, e.g., "I feel guilty when I don't exercise"), identified regulation (four items, e.g., "I value the benefits of exercise"), and intrinsic motivation (four items, e.g., "I exercise because it's fun"). Support for the structural and criterion validity of scores derived from the BREQ-2 has been reported previously (e.g., Markland & Tobin, 2004), and internal consistency estimates (α) for the subscales in this investigation were .81 (amotivation), .77 (external regulation), .74 (introjected regulation), .80 (identified regulation), and .89 (intrinsic motivation).

Exercise Experiences. Before the class, participants reported their exercise experiences using the 12-item Subjective Exercise Experiences Scale (SEES; McAuley & Courneya, 1994). The SEES is designed to assess three distinct categories, namely, positive well-being (4 items, e.g., "great," "strong"), psychological distress (4 items, e.g., "miserable," "awful"), and fatigue (4 items, e.g., "drained," "tired"). A response scale anchored at 1 (*not at all*) and 7 (*very much so*) was employed, and participants responded to the stem "Right now, I feel . . ." McAuley and Courneya (1994) demonstrated support for the factorial validity and reliability of scores derived from the SEES, and in the current study, alpha coefficients were .89, .89, and .90 for the positive well-being, psychological distress, and fatigue subscales, respectively.

Threat. Consistent with the measurement of threat reported in previous inoculation work (e.g., Jackson et al., 2015), one item was used to assess participants' perceptions of threat before the exercise circuit. Participants were asked to respond to the statement "How likely do you think it is that you will be faced with challenges to your positive thoughts about exercise during this upcoming session . . .," using a bipolar response scale anchored at 1 (*unlikely*) and 7 (*likely*).

Instructor Convincingness. Following the class, participants were asked to respond to two items that were designed to assess the extent to which they believed the instructor was convincing. Using a 7-point response scale ranging from 1 (*not at all true*) to 7 (*very true*), participants were asked how much they agreed with these items: "I paid attention to the instructor during the session," and "I thought the instructor was credible." A mean "convincingness" score was calculated from these two items, and scores on this scale produced a Spearman–Brown coefficient ρ of .72.

Treatment Efficacy. Following the class, participants were asked to respond to three statements that assessed their thoughts during the session. These items related specifically to the topic of the three counterargument–refutation pairings that were presented in the inoculation message. Using a 7-point response scale ranging from 1 (*not at all true*) to 7 (*very true*), participants responded to "The instructor's style of interaction negatively influenced my thoughts about the exercise session," "I got bored a lot during the exercise session," and "I found myself questioning the benefits of the exercise session". Accordingly, a higher aggregate score on these three items indicated that participants had experienced the planned "motivational challenges" to a greater extent. The internal consistency (α) of this treatment efficacy instrument was .76.

Class-Related Variables

Class Motivational Perceptions. Following the completion of the circuit, participants reported their perceptions regarding the session using two subscales from the Intrinsic Motivation Inventory (IMI; Ryan, 1982). Using a response scale anchored at 1 (*not at all true*) and 7 (*very true*), participants completed the seven-item interest–enjoyment subscale (e.g., "I enjoyed the exercise session very much," "I would describe the exercise session as very interesting") and the seven-item value–usefulness subscale (e.g., "I believe the exercise session was of some value to me," "I believe doing the exercise session was beneficial to me") from the IMI. These two subscales were selected as they mapped conceptually onto key aspects of autonomous exercise motives (i.e., interest, enjoyment, value). Evidence to support the validity and reliability of scores derived from the IMI subscales has been reported previously (e.g., McAuley, Duncan, & Tammen, 1989), and in this investigation, we observed internal consistency estimates (α) of .90 (interest–enjoyment) and .95 (value–usefulness).

Instructor-Related Variables

Perceptions of Instructor Need Support. Fifteen items were used to measure participants' perceptions of instructor need support (i.e., relatedness, autonomy, and competence support) in the postsession questionnaire. Perceptions of interpersonal involvement, or relatedness support, were measured using five items derived from a previously used relatedness support instrument (Standage et al., 2005). Following the stem "This instructor . . . ," participants responded to items such as ". . . supported me" and "respected me." To assess autonomy support, participants completed the six-item version of the Learning Climate Questionnaire (LCQ; Williams & Deci, 1996). Participants were asked to respond to a series of statements about how they viewed their instructor's behavior during the session (e.g., "I felt that the instructor provided us with choices and options"). To assess perceptions of structure, or competence support, we used a four-item questionnaire adapted from Standage et al.'s (2005) physical education instrument. Specifically, participants responded to statements including, "The instructor helped me to improve," and "The instructor made me feel like I was good at the activity." The response scale for all need support instruments was anchored at 1 (*strongly disagree*) and 7 (*strongly agree*), and aggregate scores were derived for each of the three variables. Support for aspects of validity (e.g., unidimensionality) and reliability (i.e., internal consistency) have been reported previously for scores derived from these need support scales (e.g., Soenens & Vansteenkiste, 2005; Standage et al., 2005; Williams & Deci, 1996). Alpha coefficients of .91 (relatedness), .87 (autonomy), and .89 (competence) were obtained for scores on these subscales in the current study.

Instructor Impact. To examine whether the effect of the instructor's interaction style on participants' experiences differed by condition, we included a single item, "What impact did you feel the instructor had on your thoughts about the exercise session?", using a response scale anchored at –3 (*strong negative impact*), 0 (*no impact at all*), and 3 (*strong positive impact*). Accordingly, positive (negative) scores indicated that participants felt the instructor had positively (negatively) influenced their thoughts about the session.

Results

First, a missing value analysis on all primary variables was conducted using IBM SPSS (Version 22.0) and indicated that missing data (which represented less than 3% of the overall data file) were missing completely at random; Little's (1988) chi-square test was nonsignificant, $\chi^2(402) = 420.64$, $p = .25$. Missing data were imputed using the expectation maximization procedure (see Graham, 2009), excluding those who had provided completely missing data on BREQ-2 subscales. Given that these variables were used only for the purpose of background checks, complete missing data for BREQ-2 subscales were not replaced.

Preliminary Analyses

A chi-square test of association for gender-by-condition revealed that the proportion of male-to-female participants was consistent between conditions, $\chi^2(1) = 0.68$, $p = .41$, and a one-way analysis of variance (ANOVA; using those who provided their age) indicated no significant age difference between participants in the two conditions, $F(1, 134) = 0.14$, $p = .70$, $\eta^2_p = .001$. Subsequently, we performed a multivariate analysis of variance (MANOVA) to test for potential differences on participants' motivational regulations and presession exercise experiences (i.e., BREQ-2 and SEES subscale scores, excluding 7 participants who failed to provide any BREQ-2 data). Descriptive data for these and all other variables—separated by condition—are displayed in Table 1. A nonsignificant multivariate effect for condition was observed in this analysis, $F(8, 130) = 1.58$, $p = .14$, $\eta^2_p = .09$, $\lambda = .91$, which indicated that—once univariate significance was examined using a Bonferroni-adjusted alpha criterion in light of multiple comparisons—there were no significant between-conditions differences on any of these background variables. Accordingly, subsequent analyses proceeded without the inclusion of motivational or presession experience variables as covariates. It is noteworthy, though, that mean scores for intrinsic motivation ($M = 3.27$) and identified regulation ($M = 3.31$), as measured by the BREQ-2, were high in our sample (response options ranged from 0 to 4, with 4 described as *very true of me*). Consequently, our use of an inoculation message designed to protect perceptions related to self-determination in exercise was appropriate for this population.

To examine between-conditions differences on perceptions of threat (measured before the activity), instructor convincingness, and treatment efficacy, we ran a one-way MANOVA, with condition as the independent factor. This analysis revealed a significant multivariate effect for condition, $F(3, 141) = 4.25$, $p = .007$, $\eta^2_p = .08$, $\lambda = .92$. Using a Bonferroni-adjusted alpha criterion at the univariate level in light of multiple comparisons (i.e., .05/3 = .017), the significant multivariate effect was accounted for by significant differences in terms of treatment efficacy, $F(1, 143) = 18.53$, $p = .002$, $\eta^2_p = .07$. As shown in Table 1, participants in the inoculation condition reported experiencing the in-session "motivational challenges" (i.e., the controlling style, potential boredom, questioning the benefits of the session) to a significantly lower degree than those in the control condition. There were no differences between control and inoculation groups in terms of perceived threat to one's positive exercise thoughts, $F(1, 143) = 0.07$, $p = .79$, $\eta^2_p = .001$, or in terms of participants' perceptions regarding the convincingness of the instructor, $F(1, 143) = 0.09$, $p = .77$, $\eta^2_p = .001$. In addition to inspection of significance at the univariate level, we undertook a discriminant function analysis to determine the variables responsible for differences between experimental conditions. In support of our univariate ANOVA analyses, examination of

Table 1 Descriptive Statistics According to Condition

	Inoculation (*n* = 72)		Control (*n* = 74)	
Variable	***M***	***SD***	***M***	***SD***
Background variables and manipulation checks				
Amotivation	0.23	0.42	0.12	0.27
External regulation	0.87	0.67	0.62	0.58
Introjected regulation	2.29	0.86	2.24	0.94
Identified regulation	3.32	0.65	3.30	0.67
Intrinsic motivation	3.32	0.63	3.22	0.68
Positive well-being	4.44	1.13	4.21	1.16
Psychological distress	1.89	1.01	1.87	1.06
Fatigue	3.28	1.51	3.27	1.40
Threat	3.33	1.80	3.23	1.49
Instructor convincingness	4.71	1.37	4.64	1.54
Treatment efficacy	2.47	1.10	3.18	1.54
Instructor and class-related perceptions				
Interest–enjoyment	4.33	1.07	3.78	1.27
Value–usefulness	5.20	1.17	4.82	1.52
Relatedness support	3.65	1.39	2.84	1.22
Autonomy support	2.50	1.14	1.79	0.90
Competence support	3.67	1.68	2.88	1.36
Instructor impact	0.65	1.16	–.53	1.56

Note. Response scales were as follows: BREQ-2 subscales 0–4, with higher scores denoting stronger endorsement of that type of motivation; positive well-being, psychological distress, fatigue 1–7, with higher scores indicating stronger perceptions on focal construct; threat 1–7, with higher scores denoting greater threat; instructor convincingness 1–7, with higher scores denoting greater convincingness; treatment efficacy 1–7, with lower scores denoting participants experienced "motivational challenges" to a lower extent; interest–enjoyment and value–usefulness 1–7, with higher scores indicating more positive perceptions; need support 1–7, with higher scores reflecting greater need support; instructor impact –3–3, with positive (negative) scores indicating participants felt the instructor had a positive (negative) impact on their thoughts about the session.

structure coefficients in the discriminant function analysis revealed that only treatment efficacy was well correlated with the function variable (.89). The structure coefficients for threat (–.07) and instructor convincingness (–.08) indicated that these variables were weakly correlated with the discriminant function.

Main Analyses

Our main analysis examined between-conditions differences on class- and instructor-related perceptions, and we grouped (a) interest–enjoyment, (b) value–usefulness, (c) need support (i.e., separate relatedness, autonomy, and competence support indices), and (d) the perceived impact of the instructor as dependent variables within a single one-way MANOVA. Analyses revealed a significant multivariate effect for condition, $F(6, 139) = 5.40$, $p < .001$, $\eta^2_p = .19$, $\lambda = .81$, which was followed up at the univariate level using a Bonferroni-adjusted alpha criterion in light of multiple comparisons (i.e., .05/6 = .008). Inspection of univariate output revealed that this multivariate effect was accounted for by significant differences on interest–enjoyment, $F(1, 144) = 8.08$, $p = .005$, $\eta^2_p = .05$; relatedness support, $F(1, 144) = 13.84$, $p < .001$, $\eta^2_p = .09$; autonomy support, $F(1, 144) = 17.85$, $p < .001$, $\eta^2_p = .11$; competence support, $F(1, 144) = 9.57$, $p = .002$, $\eta^2_p = .06$; and the impact of the instructor on individuals' thoughts, $F(1, 144) = 26.82$, $p < .001$, $\eta^2_p = .16$. Analysis of descriptive data (Table 1) demonstrated that, relative to their counterparts in the control condition, inoculated participants reported significantly greater interest–enjoyment perceptions and perceived, on average, that the instructor had a weak positive impact on their in-session thoughts (vs. a weak negative impact in the control group). Compared with inoculated participants, those in the control group also reported significantly lower perceptions of need support across all three psychological needs. There were no significant between-conditions differences on perceptions of value–usefulness, $F(1, 144) = 2.88$, $p = .09$, $\eta^2_p = .02$. Inspection of structure coefficients in a discriminant function analysis supported results from our univariate ANOVAs. That is, structure coefficients for instructor impact (.89), autonomy support (.73), relatedness support

(.64), competence support (.53), and interest–enjoyment (.49) indicated that these variables were correlated with the discriminant function more than perceptions of value–usefulness (.29).

In light of the significant effect we observed for interest–enjoyment, we performed supplementary analyses—guided by SDT principles—with the aim of examining the extent to which participants' need support perceptions might mediate the relationship between condition assignment (i.e., inoculation or control) and participants' interest–enjoyment. To do so, we used Hayes's (2013) PROCESS Version 2.15 macro for SPSS with bootstrapping for multiple mediation. We entered treatment (coded 1 for inoculation and 0 for control) as the independent variable (IV), the three need support perceptions as proposed mediators (M), and class-related interest–enjoyment as the dependent variable (DV). In line with findings reported above, analyses of IV → M pathways revealed significant effects for treatment in relation to relatedness support (*estimate* = .81, *SE* = .22, t = 3.72, $p < .001$), autonomy support (*estimate* = .72, *SE* = .17, $t = 4.22$, $p < .001$), and competence support (*estimate* = .78, *SE* = .25, $t = 3.09$, $p = .002$). In terms of M → DV pathways, we observed a significant relationship between relatedness support and interest–enjoyment (*estimate* = .35, *SE* = .10, $t = 3.44$, $p < .001$), which indicated that greater perceptions of instructor relatedness support were related to enhanced class interest–enjoyment (no other significant M → DV pathways emerged). The confidence interval for the bootstrapped total indirect effect from treatment to interest–enjoyment (through relatedness support) excluded zero (*estimate* = .28, *SE* = .12, 95% bias corrected confidence interval [.10, .59]), and the overall normal theory test associated with the indirect effect for relatedness support was significant ($z = 2.48$, $p = .01$). In sum, these analyses indicated that, relative to the control treatment, the inoculation treatment elicited (among other things) enhanced relatedness need support perceptions, which in turn promoted greater interest–enjoyment regarding the exercise session. For the interested reader, zero-order correlations between all study variables are displayed in Table 2.

Discussion

Self-determined exercise motivation reflects the pursuit of exercise due to volitional, self-endorsed reasons (Ryan & Deci, 2007). It is a desirable form of motivation because it is associated with behavioral persistence and other adaptive outcomes (see Teixeira et al., 2012), but it is also precarious because it can be supported or undermined by social conditions (Ryan & Deci, 2007). Guided by literature on SDT and inoculation theory, we tested the efficacy of an inoculation message at conferring resistance to positive exercise perceptions that are associated with self-determined motivation in the face of social conditions that are known to undermine these perceptions. That is, participants were given an inoculation message or a control message and were then invited to take part in an exercise session in the presence of an unsupportive and critical instructor. In usual circumstances, these conditions should, theoretically speaking, pose a threat to perceptions that are inherently associated with self-determination (i.e., interest/enjoyment; value/usefulness). Thus, comparisons between messaging groups in these constructs, after ensuring that the groups did not differ in relevant variables at baseline, would provide an indication of the merits of inoculation messaging as a method of creating resistant positive perceptions in exercisers. Results indicated that, relative to participants who received an information-only control message, participants who received an inoculation message reported greater perceptions of need support from the exercise instructor, more positive perceptions of the instructor's impact, and more interest/enjoyment in the session. Moreover, analyses indicated that relatedness support perceptions mediated the relationship between message condition and interest/enjoyment.

On a practical level, the study is important because exercise motivations are fragile (Maher, Gottschall, & Conroy, 2015), and exercise adherence is notoriously poor as a function of shifting motivations for exercise (Kinnafick, Thøgersen-Ntoumani, & Duda, 2014). Efforts to confer resistance to high-quality forms of motivation (i.e., self-determined motivation) are therefore valuable, especially if these efforts are inexpensive and easy to disseminate. Encouragingly, despite possessing similar levels of intrinsic motivation for exercise at baseline, recipients of our inoculation message reported greater interest/enjoyment of the exercise session than recipients of the control message. Interest and enjoyment are markers of intrinsic motivation, which sits at the apex of the self-determination continuum, and it is this form of motivation that has been discussed as a key predictor of long-term exercise adherence (Lewis, Williams, Frayeh, & Marcus, 2016; Ryan & Deci, 2007; Teixeira, Carraça, Markland, Silva, & Ryan, 2012). That being the case, it would be interesting to explore the effects of inoculation messaging on intrinsic motivation and exercise adherence throughout the duration of an exercise program. Such research could be undertaken with or without the administration of multiple inoculation treatments (i.e., inoculation boosters; see, e.g., Pfau et al., 2006), with some research indicating that single inoculation messages can be impactful for a considerable amount of time without the need for booster messages. For example, Pfau and Van Bockern (1994) observed that smoking inoculation messages given to school students offered some potential to arrest attitude slippage many months after the students had received the message.

Although significant differences in key outcome variables were observed between message groups in this study, it is noteworthy that significant differences were not observed between the groups in their perceptions of value–usefulness. On the surface, this nonsignificant difference is surprising. Indeed, the inoculation message included material to help individuals manage doubts about the perceived benefits of the upcoming session

Table 2 Aggregate-Level Skewness, Kurtosis, and Zero-Order Correlations for All Variables Across the Entire Sample

Variable	Skew	Kurtosis	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
1. Amotivation	2.31	5.74	—	.51	–.19	–.58	–.43	–.26	.33	.16	.20	–.02	–.04	.01	–.05	.01	.12	.03	.09
2. External regulation	0.55	–0.75		—	.08	–.27	–.32	–.22	.25	.21	.32	.03	–.04	.06	.08	.03	.04	.06	.12
3. Introjected regulation	0.09	–0.60			—	.50	.30	.04	.09	.16	.08	.05	.06	.14	.09	–.02	–.07	.01	–.01
4. Identified regulation	–0.86	–0.09				—	.64	.36	–.28	–.02	–.18	.01	.10	.06	.04	–.07	–.19	–.03	–.12
5. Intrinsic motivation	–0.66	–0.28					—	.40	–.27	–.16	–.17	–.02	.06	.12	.06	–.01	–.14	–.09	–.06
6. Positive well-being	0.04	–0.10						—	–.64	–.60	–.29	.08	–.08	.16	.20	.01	–.14	–.01	.01
7. Psychological distress	1.48	1.79							—	.66	.25	–.08	.18	–.14	–.13	–.05	.09	–.01	–.06
8. Fatigue	0.50	–0.66								—	.20	–.15	.22	–.15	–.23	–.08	–.01	–.06	–.08
9. Threat	0.28	–0.89									—	.04	.11	.01	.02	–.04	–.05	–.01	.04
10. Instructor convincingness	–0.34	–0.42										—	–.46	.47	.40	.42	.36	.51	.41
11. Treatment efficacy	0.80	0.33											—	–.70	–.54	–.59	–.44	–.44	–.60
12. Interest–enjoyment	–0.15	0.07												—	.60	.49	.38	.34	.44
13. Value–usefulness	–0.67	0.14													—	.35	.14	.24	.32
14. Relatedness support	0.38	–0.05														—	.73	.66	.60
15. Autonomy support	1.15	1.29															—	.62	.49
16. Competence support	0.30	–0.72																—	.61
17. Instructor impact	–0.12	–0.85																	—

Note. | $r \geq .17$ | = $p < .05$. | $r \geq .22$ | = $p < .01$. | $r \geq .30$ | = $p < .001$.

exercise, and results also indicated that the inoculation group perceived greater need-supportive conditions that are often considered as facilitative of value–usefulness perceptions (see, e.g., Markland & Tobin, 2010). Our nonsignificant finding in relation to value–usefulness may reflect the possibility that these perceptions are less susceptible to change relative to perceptions of interest/enjoyment. In other words, in exercise sessions led by unsupportive instructors, it is possible that participants could still find personal value in the exercise despite not enjoying the experience (e.g., "I didn't enjoy the session at all, but I still burned calories and accrued benefits for my physical health"). Of course, unsupportive exercise instructors might undermine positive social interactions that may have otherwise been considered as valuable outcomes, but individuals may still have faith in the positive health benefits of exercise regardless of the social climate created by an exercise instructor.

Participants in our two messaging groups did not differ in exercise motivation before the exercise class, with mean scores indicating that, regardless of condition, participants possessed high levels of both intrinsic motivation and identified regulation. This was important because inoculation treatments are preventive in nature and require a construct (in our case, value and enjoyment/interest perceptions) to be in place in order for the messages to work effectively. Our main findings were also strengthened by the nonsignificant difference in perceptions of instructor convincingness between message groups, with findings suggesting that both groups perceived the instructor to be convincing. Regardless of messaging condition, participants felt that they paid attention to the credible instructor, meaning that the challenges faced by participants were unlikely to be perceived as artificial or staged. Moreover, our findings relating to perceptions of instructor convincingness, together with our findings for need support and instructor impact, provide clues as to the mechanisms through which the inoculation messages were impactful in this study. That is, whereas participants across the conditions were equally aware of the challenges provided by the instructor, participants in the inoculation condition were more able to see the instructor's impact as positive and need supportive.

In the current study, we assessed exercisers' perspectives of support from the instructor rather than assessing their feelings of need satisfaction or need thwarting. This approach was chosen because we were interested in participants' perceptions of the instructor's behavior, and although the Psychological Need Thwarting Scale—Physical Activity (Gunnell, Crocker, Wilson, Mack, & Zumbo, 2013) assesses negative exercise experiences, it measures feelings of need thwarting rather than instructor-based behaviors. In addition, it is possible that, in some cases, inoculation messages could lead to contrast effects in relation to expectancies and actual observation (Jackson et al., 2015). In our case, inoculated participants might have expected the instructor to be especially unsupportive and controlling given that they were given a written message to warn them about this possibility. After observing the instructor's behavior, however, these participants might have been surprised that the behavior was not as unpleasant as what they had expected, and this discrepancy between expectancy and observation may have led participants to engage in upward evaluations of the instructor. Indeed, our data on the need support measures indicated that participants felt reasonably positive about the instructor given the circumstances, but those in the inoculation group were particularly positive about the instructor's need-supportive behavior.

It was interesting that participants' perspectives on instructor impact, as assessed by our single-item measure, was significantly different between the inoculation and control groups. What made this difference especially interesting was that the mean score on this measure fell above the midpoint for inoculation participants (i.e., representing a positive impact of the instructor on thoughts about the exercise session) but below the midpoint for control participants (i.e., representing a negative impact of the instructor on thoughts about the exercise session). Put differently, participants reported scores that are consistent with tenets in SDT—that perceptions of instructor behavior relevant to provisions for autonomy, competence, and relatedness can have a positive or negative impact on overall experiences in exercise. Critically, our inoculation treatment seemed sufficient to influence these perceptions to a point where the instructor was deemed to have a positive, rather than negative, impact on evaluations of the exercise session.

We recognize that this study is not without limitations. Our sample was comprised of undergraduate kinesiology students, so it is difficult to generalize the findings to other groups, and we recommend similar work on the inoculation of motivation in other cohorts. Furthermore, in terms of practical relevance of the research, communicators may find it difficult to forecast when (or even if) an individual will face unsupportive and critical exercise instructors. Indeed, the frequency with which exercisers are faced with challenging conditions such as those used in this study remains to be determined. It is possible that the types of challenges used in the current study are limited to particular group-based exercise classes (e.g., military-based, boot-camp exercises); thus, more research is needed to determine the extent to which exercisers' motivation is challenged by social conditions and task requirements.

Aside from these issues, a nice addition to the current study would have been to employ an individual to code instructor behavior across the exercise sessions. That said, we were confident that the instructor was consistent in his interactions across sessions because he was blinded to the condition to which participants had been assigned, observers were confident that the instructor's behavior was consistent over time, and instructor convincingness scores were consistent across messaging groups. In relation to issues associated with self-report instruments used in the current study, we are mindful that integrated

regulation, which is now commonly assessed as part of the motivation continuum, was not assessed at baseline, and that, in hindsight, Markland and Tobin's (2010) measure of need support in exercise would have been well suited for use in our study. We are also aware that criticisms have been leveled at the Subjective Exercise Experiences Scale (see Ekkekakis & Petruzzello, 2001), which was used in the present investigation. Finally, our findings were limited to self-report, and while there is obvious value in findings of this nature, we recommend further work in this area in which objective outcomes, such as energy output and exercise behavior, are measured. Despite these limitations, we were encouraged that the results in the current study provide strong support for the potential of inoculation communications to protect positive perceptions of exercise that are associated with self-determined motivation.

References

Banas, J.A., & Rains, S.A. (2010). A meta-analysis of research on inoculation theory. *Communication Monographs, 77*(3), 281–311. doi:10.1080/03637751003758193

Bartholomew, K.J., Ntoumanis, N., Ryan, R.M., Bosch, J.A., & Thogersen-Ntoumani, C. (2011). Self-determination theory and diminished functioning: The role of interpersonal control and psychological need thwarting. *Personality and Social Psychology Bulletin, 37*(11), 1459–1473. PubMed doi:10.1177/0146167211413125

Chatzisarantis, N.L.D., Hagger, M.S., Biddle, S.J.H., Smith, B., & Wang, J.C.K. (2003). A meta-analysis of perceived locus of causality in exercise, sport, and physical education contexts. *Journal of Sport & Exercise Psychology, 25,* 284–306. doi:10.1123/jsep.25.3.284

Compton, J., Jackson, B., & Dimmock, J.A. (2016). Persuading others to avoid persuasion: Inoculation theory and resistant health attitudes. *Frontiers in Psychology, 7*. PubMed doi:10.3389/fpsyg.2016.00122

Costa, S., Ntoumanis, N., & Bartholomew, K.J. (2015). Predicting the brighter and darker sides of interpersonal relationships: Does psychological need thwarting matter? *Motivation and Emotion, 39,* 11–24. doi:10.1007/s11031-014-9427-0

Deci, E.L., & Ryan, R.M. (1985). *Intrinsic motivation and self-determination in human behavior*. New York, NY: Plenum Press. doi:10.1007/978-1-4899-2271-7

Deci, E.L., & Ryan, R.M. (2000). The "what" and the "why" of goal pursuits: Human needs and the self-determination of behavior. *Psychological Inquiry, 11,* 227–268. doi:10.1207/S15327965PLI1104_01

De Meyer, J., Tallir, I.B., Soenens, B., Vansteenkiste, M., Aelterman, N., Van den Berghe, L., . . . Haerens, L. (2014). Does observed controlling teaching behavior relate to students' motivation in physical education? *Journal of Educational Psychology, 106*(2), 541–554. doi:10.1037/a0034399

Eagly, A.H., & Chaiken, S. (1993). *The psychology of attitudes*. Orlando, FL: Harcourt Brace Jovanovich.

Edmunds, J., Ntoumanis, N., & Duda, J.L. (2006). A test of self-determination theory in the exercise domain. *Journal of Applied Social Psychology, 36,* 2240–2265. doi:10.1111/j.0021-9029.2006.00102.x

Ekkekakis, P., & Petruzzello, S.J. (2001). Analysis of the affect measurement conundrum in exercise psychology: III. A conceptual and methodological critique of the Subjective Exercise Experiences Scale. *Psychology of Sport and Exercise, 2*(4), 205–232. doi:10.1016/S1469-0292(01)00022-X

Gillison, F.B., Standage, M., & Skevington, S.M. (2006). Relationships among adolescents' weight perceptions, exercise goals, exercise motivation, quality of life and leisure time exercise behaviour: A self-determination theory approach. *Health Education Research, 21*(6), 836–847. PubMed doi:10.1093/her/cyl139

Graham, J.W. (2009). Missing data analysis: Making it work in the real world. *Annual Review of Psychology, 60,* 549–576. PubMed doi:10.1146/annurev.psych.58.110405.085530

Gunnell, K.E., Crocker, P.R.E., Wilson, P.M., Mack, D.E., & Zumbo, B.D. (2013). Psychological need satisfaction and thwarting: A basic test of psychological needs theory in physical activity contexts. *Psychology of Sport and Exercise, 14*(5), 599–607. doi:10.1016/j.psychsport.2013.03.007

Hayes, A.F. (2013). *Introduction to mediation, moderation, and conditional process analysis: A regression-based approach*. New York, NY: Guilford Press.

Hodge, K., Lonsdale, C., & Ng, J.Y.Y. (2008). Burnout in elite rugby: Relationships with basic psychological needs fulfillment. *Journal of Sports Sciences, 26*(8), 835–844. PubMed doi:10.1080/02640410701784525

Hodgins, H.S., Weibust, K.S., Weinstein, N., Shiffman, S., Miller, A., Coombs, G., & Adair, K.C. (2010). The cost of self-protection: Threat response and performance as a function of autonomous and controlled motivations. *Personality and Social Psychology Bulletin, 36*(8), 1101–1114. PubMed doi:10.1177/0146167210375618

Jackson, B., Compton, J., Thornton, A.L., & Dimmock, J.A. (2017). Re-thinking anxiety: Using inoculation messages to reduce and reinterpret public speaking fears. *PLoS ONE, 12*(1): e0169972. doi:10.1371/journal.pone.0169972.

Jackson, B., Compton, J., Whiddett, R., Anthony, D.R., & Dimmock, J.A. (2015). Preempting performance challenges: The effects of inoculation messaging on attacks to task self-efficacy. *PLoS One, 10*(4), e0124886. PubMed doi:10.1371/journal.pone.0124886

Kinnafick, F.-E., Thøgersen-Ntoumani, C., & Duda, J.L. (2014). Physical activity adoption to adherence, lapse, and dropout: A self-determination theory perspective. *Qualitative Health Research, 24*(5), 706–718. PubMed doi:10.1177/1049732314528811

Lewis, B.A., Williams, D.M., Frayeh, A., & Marcus, B.H. (2016). Self-efficacy versus perceived enjoyment as predictors of physical activity behavior. *Psychology & Health, 31*(4), 456–469. PubMed doi:10.1080/08870446.2015.1111372

Little, R.J.A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association, 83*(404), 1198–1202. doi:10.1080/01621459.1988.10478722

Maher, J.P., Gottschall, J.S., & Conroy, D.E. (2015). Perceptions of the activity, the social climate, and the self during group exercise classes regulate intrinsic satisfaction. *Frontiers in Psychology, 6,* 1236. PubMed doi:10.3389/fpsyg.2015.01236

Markland, D., & Tobin, V. (2004). A modification of the Behavioural Regulation in Exercise Questionnaire to include an assessment of amotivation. *Journal of Sport & Exercise Psychology, 26,* 191–196. doi:10.1123/jsep.26.2.191

Markland, D., & Tobin, V.J. (2010). Need support and behavioural regulations for exercise among exercise referral scheme clients: The mediating role of psychological need satisfaction. *Psychology of Sport and Exercise, 11*(2), 91–99. doi:10.1016/j.psychsport.2009.07.001

Mask, L., & Blanchard, C.M. (2011). The protective role of general self-determination against 'thin ideal' media exposure on women's body image and eating-related concerns. *Journal of Health Psychology, 16,* 489–499. PubMed doi:10.1177/1359105310385367

McAuley, E., & Courneya, K.S. (1994). The Subjective Exercise Experiences Scale (SEES): Development and preliminary validation. *Journal of Sport & Exercise Psychology, 16,* 163–177. doi:10.1123/jsep.16.2.163

McAuley, E., Duncan, T., & Tammen, V.V. (1989). Psychometric properties of the Intrinsic Motivation Inventory in a competitive sport setting. *Research Quarterly for Exercise and Sport, 60,* 48–58. PubMed doi:10.1080/02701367.1989.10607413

McGuire, W.J. (1961a). The effectiveness of supportive and refutational defenses in immunizing and restoring beliefs against persuasion. *Sociometry, 24,* 184–197. doi:10.2307/2786067

McGuire, W.J. (1961b). Resistance to persuasion conferred by active and passive prior refutation of the same and alternative counterarguments. *Journal of Abnormal and Social Psychology, 63,* 326–332. doi:10.1037/h0048344

McGuire, W.J. (1964). Inducing resistance to persuasion: Some contemporary approaches. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (pp. 191–229). New York, NY: Academic Press.

Mouratidis, A., Vansteenkiste, M., Lens, W., & Sideridis, G. (2008). The motivating role of positive feedback in sport and physical education: Evidence for a motivational model. *Journal of Sport & Exercise Psychology, 30,* 240–268. PubMed doi:10.1123/jsep.30.2.240

Ng, J.Y.Y., Ntoumanis, N., Thogersen-Ntoumani, E.C., Deci, E.L., Ryan, R.M., Duda, J.L., & Williams, G.C. (2012). Self-determination theory applied to health contexts: A meta-analysis. *Perspectives on Psychological Science, 7,* 325–340. PubMed doi:10.1177/1745691612447309

Pfau, M., Compton, J., Parker, K.A., An, C., Wittenberg, E.M., Ferguson, M., . . . Malyshev, Y. (2006). The conundrum of the timing of counterarguing effects in resistance: Strategies to boost the persistence of counterarguing output. *Communication Quarterly, 54*(2), 143–156. doi:10.1080/01463370600650845

Pfau, M., & Van Bockern, S. (1994). The persistence of inoculation in conferring resistance to smoking initiation among adolescents: The second year. *Human Communication Research, 20*(3), 413–430. doi:10.1111/j.1468-2958.1994.tb00329.x

Ryan, R.M. (1982). Control and information in the intrapersonal sphere: An extension of cognitive evaluation theory. *Journal of Personality and Social Psychology, 43*(3), 450–461. doi:10.1037/0022-3514.43.3.450

Ryan, R.M., & Deci, E.L. (2007). Active human nature: Self-determination theory and the promotion and maintenance of sport, exercise, and health. In M.S. Hagger & N.L.D. Chatzisarantis (Eds.), *Intrinsic motivation and self-determination in exercise and sport* (pp. 1–19). Champaign, IL: Human Kinetics.

Soenens, B., & Vansteenkiste, M. (2005). Antecedents and outcomes of self-determination in 3 life domains: The role of parents' and teachers' autonomy support. *Journal of Youth and Adolescence, 34*(6), 589–604. doi:10.1007/s10964-005-8948-y

Standage, M., Duda, J.L., & Ntoumanis, N. (2005). A test of self-determination theory in school physical education. *The British Journal of Educational Psychology, 75*(3), 411–433. PubMed doi:10.1348/000709904X22359

Sylvester, B.D., Standage, M., McEwan, D., Wolf, S.A., Lubans, D.R., Eather, N., . . . Beauchamp, M.R. (2016). Variety support and exercise adherence behavior: Experimental and mediating effects. *Journal of Behavioral Medicine, 39,* 214–224. PubMed doi:10.1007/s10865-015-9688-4

Teixeira, P.J., Carraça, E.V., Markland, D., Silva, M.N., & Ryan, R.M. (2012). Exercise, physical activity, and self-determination theory: A systematic review. *The International Journal of Behavioral Nutrition and Physical Activity, 9,* 78. PubMed doi:10.1186/1479-5868-9-78

Tessier, D., Sarrazin, P., & Ntoumanis, N. (2010). The effect of an intervention to improve newly qualified teachers' interpersonal style, students' motivation and psychological need satisfaction in sport-based physical education. *Contemporary Educational Psychology, 35*(4), 242–253. doi:10.1016/j.cedpsych.2010.05.005

Vansteenkiste, M., & Ryan, R.M. (2013). On psychological growth and vulnerability: Basic psychological need satisfaction and need frustration as a unifying principle. *Journal of Psychotherapy Integration, 23*(3), 263–280. doi:10.1037/a0032359

Vansteenkiste, M., Simons, J., Soenens, B., & Lens, W. (2004). How to become a persevering exerciser? Providing a clear, future intrinsic goal in an autonomy-supportive way. *Journal of Sport & Exercise Psychology, 26,* 232–249. doi:10.1123/jsep.26.2.232

Williams, G.C., & Deci, E.L. (1996). Internalization of biopsychosocial values by medical students: A test of self-determination theory. *Journal of Personality and Social Psychology, 70*(4), 767–779. PubMed doi:10.1037/0022-3514.70.4.767

Wilson, P.M., & Rodgers, W.M. (2002). The relationship between exercise motives and physical self-esteem in female exercise participants: An application of self-determination theory. *Journal of Applied Biobehavioral Research, 7*(1), 30–43. doi:10.1111/j.1751-9861.2002.tb00074.x

Appendix A: Control Message

Exercise Circuit—Information

About the Circuit. Today, you will undertake a circuit exercise class. This class will last for 25 minutes, and you will be asked to complete a short survey before and after the exercise session. This class is part of a series of classes that are designed to help us investigate the relationship between exercise duration and mood, and members of different classes will complete sessions of differing lengths.

Appendix B: Inoculation Message

Exercise Circuit—Information

About the Circuit. Today, you will undertake a circuit exercise class. This class will last for 25 minutes, and you will be asked to complete a short survey before and after the exercise session. This class is part of a series of classes that are designed to help us investigate the relationship between exercise duration and mood, and members of different classes will complete sessions of differing lengths.

But, be aware, your positive thoughts about exercise might be challenged in this particular exercise circuit.

1. *You might start to wonder whether this exercise circuit offers many benefits.* Research indicates that as little as 25 minutes of physical activity can be extremely beneficial for your mental and physical health. Circuit classes, in particular, have been shown to offer many benefits, due in part to their focus on both anaerobic and aerobic systems.
2. *You could think that this exercise circuit is boring and monotonous.* There are ways to make the activities interesting and enjoyable to you. When you return to a station, for example, you can look for ways to vary the activity (e.g., change your technique, focus on something different about the activity). You can also look at others to see what you can do next, and you can challenge yourself in a multitude of interesting ways, such as beating a previous score on a task. Seek, and you shall find! Look for fun and you'll find it.
3. *The instructor might seem demanding and forceful.* The instructor has been asked to follow strict guidelines for this activity. Some of these guidelines relate to carrying out the activity with speed and efficiency, so please don't interpret his approach as being cold and controlling. He's actually a nice guy! Don't let the instructor's approach take anything away from your perceptions of enjoyment or benefits in the activity, or about your perceptions of him generally.