

AFFECTIVE CONSEQUENCES OF IMPOSING THE INTENSITY OF PHYSICAL ACTIVITY: DOES THE LOSS OF PERCEIVED AUTONOMY MATTER?

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Abstract: There is a common belief that, when allowed to select their exercise intensity, most people choose levels too low to accrue substantial benefits. Thus, one of the presumed functions of exercise practitioners is to "push" participants. A previous study showed that, if the imposed intensity exceeds the self-selected by even 10%, this suffices to reduce pleasure. Here, we isolated the effect of autonomy loss by having participants (a) exercise at a self-selected intensity and (b) exercise at an intensity set by the experimenter, which was identical to the self-selected. This reduced perception of autonomy and choice, and also attenuated increases in energy and levels of interest/enjoyment after the controlled condition. These effects could not be accounted for by differences in intensity, perceived competence, or self-efficacy. Thus, consistent with self-determination theory, loss of perceived autonomy in setting one's level of exercise intensity can negatively impact affect, with potentially negative implications for adherence.

Key words: Affective valence, Arousal, Exercise prescription, Perceived exertion.

INTRODUCTION

Physical inactivity currently represents one of the greatest public health challenges for most industrialized countries. The World Health Organization (2003) estimates that the human toll exacted by physical inactivity amounts to approximately 1.9 million deaths and 19 million disability-adjusted life-years lost annually. Although research has made great strides in establishing a causal relationship between regular physical activity and the prevention of chronic disease and dis-

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ability (Lees & Booth, 2004; Pedersen & Saltin, 2006; Warburton, Nicol, & Bredin, 2006), efforts to understand the behavioral mechanisms underlying the processes of engaging in, adhering to, and disengaging from physical activity have met with limited success (Lewis, Marcus, Pate, & Dunn, 2002; Marcus et al., 2006).

In the United States, physical inactivity is considered such a serious threat to public health that the promotion of physical activity was designated as the nation's top priority in the federal Healthy People 2000 program (National Center for Health Statistics, 2001). Despite the resources leveraged by this initiative, according to data from the Behavioral Risk Factor Surveillance System, by the year 2000, 27.4% of adults over the age of 18 years reported no participation in leisure-time physical activity and 45.4% did not achieve the minimum recommended level of 30 min of moderate activity daily (Macera et al., 2005).

Although these figures may seem ominous, those for the Greek population indicate an even larger problem (Tzormpatzakis & Slep, 2007). According to data from Eurostat (2002), 80.3% of Greek adults (75.5% of men, 84.9% of women) answered "no" to the question "Do you exercise at least twice a week?" This percentage was the highest among the country-members of the European Union. Similarly, based on a large sample (1514 men, 1528 women, 20-89 years of age) from the Attica region (including the capital city of Athens), 47% of men and 52% of women reported no participation in leisure-time physical activity (Pitsavos, Panagiotakos, Lentzas, & Stefanadis, 2005). Moreover, those who were sedentary were also significantly more likely to smoke, consume alcohol, have a poor diet, and report higher levels of depression, suggesting that lack of physical activity was only one among a cluster of unhealthy lifestyle characteristics.

The unusually low levels of physical activity in the Greek population have been attributed to a fatalistic (i.e., a perceived inability to exert control over health) and a hedonistic (i.e., a belief that the pursuit of pleasure should take precedence over health considerations) attitude that is prevalent among the Greeks (Mamalakis, Kafatos, Manios, Anagnostopoulou, & Apostolaki, 2000). In conjunction with childhood obesity rates that are among the highest in the world (Lissau et al., 2004; Mamalakis et al., 2000) and a complete absence of systematic, policy-level activity-promotion initiatives, it seems reasonable to predict that the long-term consequences of physical inactivity for Greek public health will be severe.

The paradox of physical activity is that, although it is arguably "the best buy" in public health (Morris, 1994), it also seems to be a very "tough sell" as far as the public is concerned. Given a choice between physically active and sedentary behavioral choices, most individuals opt for the sedentary ones, presumably because they perceive those as more rewarding (Vara & Epstein, 1993). What this

seems to indicate is that it is probably erroneous to assume that the decision to engage in or continue physical activity is an entirely rational process. The corollary is that appealing to the public's rational reasoning as the principal focus of intervention efforts, as is commonly done (e.g., enumerating the benefits and barriers), is unlikely to be particularly effective (Dishman & Buckworth, 1996).

The emerging alternative is based on the notion of the so-called "affect heuristic" as an influential force in human decision making (Kahneman, 1999; Slovic, Finucane, Peters, & MacGregor, 2002). According to this idea, whose origins can be traced in Bentham's hedonic calculus and Freud's pleasure principle, people are more likely to make behavioral choices that increase their pleasure and, conversely, tend to avoid behavioral choices that consistently decrease their pleasure or induce displeasure. Consistent with the affect heuristic, recent evidence shows that ratings of pleasure-displeasure during moderate-intensity exercise significantly predict reports of physical activity 6 and 12 months later (Williams et al., 2008). Likewise, affective associations (whether physical activity has registered in memory as something pleasant or unpleasant) not only directly accounted for significant portions of the variance in physical activity but also mediated the links between cognitive variables (e.g., anticipated benefits and barriers, cognitive attitudes, perceived behavioral control) and physical activity (Kiviniemi, Voss-Humke, & Seifert, 2007).

Although the long-held assumption in exercise psychology has been that "exercise makes people feel better", recent arguments suggest that affective responses to physical activity might in fact be much more variable. For example, non-exercisers may experience less positive responses than regular exercisers (Hoffman & Hoffman, 2008) and, under some circumstances, some individuals may experience decreases in pleasure (Backhouse, Ekkekakis, Biddle, Foskett, & Williams, 2007). In fact, research conducted in the last few years has demonstrated that even small differences in the intensity of physical activity can have a significant negative impact on affective responses (Ekkekakis, Hall, & Petruzzello, 2008).

A recent study examined a hypothetical but realistic scenario, in which a previously sedentary, middle-aged woman would be prescribed walking at a speed just 10% higher than the speed she would have self-selected (Lind, Vazou, & Ekkekakis, 2008). In practical terms, this resulted in an increase in speed of just 16 cm/s (according to the literature, this is nearly identical to what happens when exercisers are instructed to walk "briskly" or "fast"). Yet, as a result of this seemingly minor change, not only did the intensity rise to unnecessarily high levels (from 84% to 91% of peak heart rate), but also ratings of pleasure-displeasure showed a significant decline over the duration of the 20-min bout (effect size $d = -.53$). Although this study demonstrated that even small changes in intensity can

significantly alter the subjective experience of physical activity, its design could not differentiate to what extent the negative effect could be attributed to the increased intensity *per se* and to what extent it was due to the loss of the sense of autonomy associated with having the experimenters set the treadmill speed.

The present study was conceived as a follow up, designed specifically to isolate the role played by the loss of autonomy. The Self-Determination Theory (SDT; Deci & Ryan, 1987, 2000) was used as the theoretical basis. Despite the central role of the construct of intrinsic motivation in SDT, research that examines affective responses to physical activity from an SDT perspective remains very limited (cf., Lutz, Lochbaum, & Turnbow, 2003; Parfitt, Rose, & Markland, 2000).

The self-determination theory

The SDT is a psychological theory that focuses on the motivational implications of self-selected (autonomous) and dictated (non-autonomous) behaviors. According to the SDT, autonomy is one of three basic psychological needs (the others being competence and relatedness), the satisfaction of which is essential for the well-being of all individuals. According to Deci and Ryan (1987, 2000), autonomy refers to the extent to which a person feels free (perceives high flexibility and low pressure) to exhibit the behavior of his or her choice, with an inner endorsement of his or her own actions. Individuals who feel autonomous are intrinsically motivated because self-determination is facilitated. Thus, autonomy is the concept that combines three qualities of perceived self-determination, namely perceived locus of causality, volition, and perceived choice (Deci & Ryan, 1987; Reeve, Nix, & Hamm, 2003).

The concept of “perceived locus of causality” reflects the individual’s perception that behavior is initiated and regulated by personal (in the case of internal focus) or by environmental (in the case of external focus) forces. The concept of “volition” reflects the perception of whether one is free or forced while engaging in an activity. The third quality of self-determination, namely “perceived choice”, refers to the perception that one has flexibility in making decisions, has opportunities to choose among different options, and has the capacity to freely alter or regulate one’s behavior during a given activity (Deci & Ryan, 1987; Reeve et al., 2003). According to Reeve et al. (2003), perceived autonomy should be defined and assessed using all three qualities, since each of these, when considered separately, fails to fully capture the meaning of perceived self-determination (Deci & Ryan, 1987; Reeve et al., 2003).

The SDT suggests that the degree of pleasure that individuals experience

when they act autonomously (e.g., when they set their own exercise intensity) will likely be higher than that experienced when behavioral parameters are externally controlled (e.g., when the intensity is imposed). Therefore, under autonomous conditions, positive affect and an absence of tension and pressure are more likely to occur and the self-determined behavior is more likely to be maintained (Deci & Ryan, 1987, 2000). Research, conducted mainly within educational settings, has generally supported this hypothesis. However, it has also become clear that various kinds of perceptions of autonomy are not equally meaningful and their influence on various types of affective responses is not uniform.

For example, in a series of studies by Reeve et al. (2003), internal locus of causality and free volition predicted students' intrinsic motivation under various experimental conditions. However, choice was effective only when the participants were given action choices (e.g., "Do you want to continue working on this puzzle or switch to a different one?"), not when they were given only option choices (e.g., "Which of these puzzles do you want to start with?"). Thus, in the present study, participants in the autonomous condition were given action choices by being allowed to not only select the initial treadmill speed but also to modify it every 5 min.

In another series of studies (Nix, Ryan, Manly, & Deci, 1999), success at autonomously motivated behaviors (task-involving and perceived-choice conditions) was related to enhancement of subjective energy and vitality compared to controlled behaviors. However, there were no differences in happiness. The authors explained this difference by arguing that happiness can simply result from succeeding or attaining a goal and «does not require pursuing goals that are conducive to growth or self-realization and does not require being autonomous in pursuing one's goals» (p. 282). In contrast, success at task-involving and, presumably, more autonomously regulated activities, in general, should be reflected in feelings of energy and vitality, «a central indicant of eudaimonia» (p. 282). Although the present study did not involve the pursuit of a specific performance goal (or success and failure in such a pursuit), we employed both a measure of the broad affective dimension of pleasure-displeasure and a measure of perceived energy.

Besides these experimental investigations, the theorized link between perceived autonomy and broadly defined positive affect has been supported in several correlational studies in educational and other contexts. For example, in a study by Black and Deci (2000), students who reported entering a course for more autonomous reasons also showed increases in perceived competence and interest/enjoyment, as well as decreases in anxiety levels, during the semester. A relationship of perceptions of autonomy with higher levels of vitality and lower levels of depression has also been found in a study with residents from 50 nursing

homes (Kasser & Ryan, 1999). Similar findings, showing higher vitality and more positive affect in daily activities among individuals with high trait autonomy were also reported in a study by Sheldon, Ryan, and Reis (1996). Further, when the environment was perceived as providing more autonomy support, students tended to report increased interest/enjoyment and reduced pressure/tension for learning (Black & Deci, 2000; Grolnick & Ryan, 1987).

The aim of the present experimental study was to examine whether manipulating an exerciser's perception of autonomy, by allowing or disallowing her to set her own exercise pace, can have an impact on affective responses. This was done while controlling for differences in the intensity of the activity (a factor that has been shown to independently influence affective responses). This control was accomplished by having the participants complete, first, one 30-min bout of treadmill activity at their self-selected intensity and, then, a second bout during which intensity was supposedly imposed by the experimenter but was actually identical to the one that had been selected by each participant during the first bout. Based on SDT, it was hypothesized that participants in the autonomous condition would report higher levels of self-determined motivation and more positive affect in comparison to the controlled condition.

METHOD

Participants

The sample consisted of 19 Greek female university students. Their ages ranged from 19 to 28 years ($M = 21$ years, $SD = 2$; mean body mass = 57.11 kg, $SD = 4.85$; mean height = 165.89 cm, $SD = 5.68$; mean body mass index = 20.67 kg·m⁻², $SD = .02$). Potential participants were screened to ensure that they were sedentary (i.e., reported that they participated in less than 30 min of daily moderate physical activity) during the previous 6 months. Seven of 19 participants had never participated in physical activity on a regular basis.

Measures

All self-report measures were first translated into Greek independently by the two co-authors. The discrepancies were minor and were resolved by consensus. The translated versions were then back-translated to English by an independent bilingual expert (Brislin, 1970), resulting in only minor modifications.

Intrinsic motivation. The 37-item Intrinsic Motivation Inventory (IMI) was used to assess the participants' subjective experience after exercise. The subscales that were used in this study were: interest/enjoyment, perceived competence, effort, value/usefulness, pressure/tension, and perceived choice. Responses were given on a 7-point scale ranging from 1 (not at all true) to 7 (very true). The validity of the IMI has been strongly supported by McAuley, Duncan, and Tammen (1989). Greek translations of the IMI have been used in several previous studies, providing information about the validity of the instrument with Greek-speaking participants. For example, Papacharisis and Goudas (2003) found that students who perceived fewer barriers to physical activity participation reported higher intrinsic motivation and Hassandra, Goudas, Hatzigeorgiadis, and Theodorakis (2007) reported that students who had undergone an intervention program focusing on fair play reported higher intrinsic motivation scores pertaining to their experiences in physical education than their counterparts in a control group. Tsigilis and Theodosiou (2003) performed an exploratory factor analysis on the factors of perceived competence, interest/enjoyment, and effort/importance and reported that these three factors accounted for 65% of the variance. Furthermore, test-retest reliability over one week was satisfactory (intra-class correlations of at least .60). In our own evaluation based on a sample of 100 Greek respondents, internal consistency using Cronbach's alpha coefficient was acceptable (interest, $\alpha = .80$; competence, $\alpha = .80$; perceived choice, $\alpha = .72$; value, $\alpha = .89$), with the exception of the effort ($\alpha = .61$) and pressure ($\alpha = .50$) subscales. Thus, the latter two subscales were excluded from the present analyses.

Perceived autonomy. The participants' perception of autonomy was assessed as a manipulation check. This construct was operationally defined in terms of three constituent qualities, namely (a) perceived locus of causality, (b) volition, and (c) perceived choice. The 12-item measure used in this study consisted of items selected from Reeve (2002, p.198), following slight modification of the wording to refer specifically to physical activity and the experimental conditions employed in this investigation; example items were: "During the physical activity, I felt pressured", "I felt like it was my own choice as to which intensity to select". In addition to the items suggested by Reeve (2002), an item measuring perceived choice over actions was also included in the perceived choice subscale. As noted in the introduction, in the present study, participants had a choice over not only the initiation but also the regulation of their behavior (i.e., the selection of treadmill speed) during the bout of treadmill activity. Thus, the additional item inquired about the perception of action choice, namely "I felt I had the choice to switch the intensity of exercise as I wished". Each item was accompanied by a 7-point

response scale, ranging from 1 (not at all true) to 7 (very much true). An overall score of perceptions of autonomy for each condition was also calculated. Internal consistency using Cronbach's alpha coefficient was acceptable for both conditions (autonomous, $\alpha = .77$; controlled, $\alpha = .88$).

Affect. Consistent with the findings of Nix et al. (1999), in this study, we employed both a measure of the broad affective dimension of pleasure-displeasure and a questionnaire that contained a measure of perceived energy. Pleasure-displeasure was assessed with the single-item, 11-point Feeling Scale (FS; Hardy & Rejeski, 1989). The FS ranges from -5 (I feel very bad) to +5 (I feel very good), with zero indicating "I feel neutral."

The 20-item Activation Deactivation Adjective Check List (AD ACL; Thayer, 1989) was used to assess the bipolar dimensions of Energetic Arousal, ranging from Energy to Tiredness, and Tense Arousal, ranging from Tension to Calmness (Ekkekakis, Hall, & Petruzzello, 2005). Responses were given on a 4-point scale ranging from 1 (definitely do not feel) to 4 (definitely feel). Internal consistency, using Cronbach's alpha coefficient, was acceptable for Energetic and Tense Arousal, both before and after the bout (pre-bout and post-bout, respectively) ranging from .74 to .85.

Self-efficacy. Self-efficacy was assessed in this study as a "negative control". In other words, we wanted to ensure that what we were manipulating was, specifically, perceived autonomy, not self-efficacy. One could argue that the unpredictability inherent in a situation in which someone else (i.e., the experimenter) is in control, could lead to self-doubt about one's ability to deal with what is to come. The self-efficacy scale was constructed in accordance with Bandura's (1986) guidelines. The participants were asked to rate their confidence in being able to continue exercising beyond the point at which exercise starts posing a challenge. The eight items ranged from stipulating a period of 2 min to stipulating a period of 16 min (i.e., in 2-min increments). For each item, the participants indicated their degree of confidence on a 0% (not confident at all) to 100% (completely confident) scale. The internal consistency of the scale using Cronbach's alpha coefficient was high ($\alpha = .97$).

Perceived exertion and heart rate. Perceived exertion and heart rate were assessed as means of quantifying the intensity of the physical activity and ensuring that both the autonomous and the controlled conditions would involve equivalent workloads. Perceived exertion was assessed with the 15-point single-item Rating of Perceived Exertion (RPE; Borg, 1998), which ranges from 6 (no exertion at all) to 20 (maximal exertion). Heart rate was assessed with a heart rate monitor (Polar Electro Oy, Kempele, Finland).

Procedure

The participants were recruited by word of mouth from the student body of a Greek university. Participation was voluntary. No external rewards were promised or delivered, to avoid influencing the participants' perceived locus of causality (Reeve et al., 2003).

The women who agreed to participate visited the laboratory twice, with an average of one week between sessions ($M = 6.74$ days, $SD = 1.37$). To control for diurnal variations in affect, sessions were scheduled at the same time of day for each participant. Furthermore, all testing took place during the same season, with minimal variation in ambient temperature and humidity. Only one participant and the same (female) investigator were present during each testing session, to control for social effects. No distractions (e.g., music or television) were present.

The participants were told that, for the first session, they were to engage in a 30-min bout of treadmill exercise, during which they would be able to set the initial speed and to modify the speed to their liking (increase it or decrease it) every 5 min (the grade was kept at 0%). For the second session, the speed of the treadmill would be controlled by the investigator. For both sessions, the control panel of the treadmill was covered (the information was only visible by the investigator).

After the participants signed an informed consent form and a demographic information questionnaire, they were asked to complete the baseline AD ACL, FS, RPE, and self-efficacy scales (a procedure that took approximately 2 min). Heart rate, RPE, and FS were recorded during the last 15 s of each 5-min period (4:45, 9:45, 14:45, 19:45, 24:45, 29:45). In addition, self-efficacy was assessed at 4:45, 14:45, and 24:45. With the exception of the last assessment time point (29:45), the participants were subsequently given the option to increase or decrease the treadmill speed. Once the 30-min bout was completed, it was followed by a five-minute cool-down period. After the treadmill was stopped, the participants were asked to complete the AD ACL, IMI, and perceived autonomy scales (a procedure that took approximately 5 min).

An identical procedure was followed during the second session, with the sole exception being that the investigator was in charge of the treadmill speed. As noted earlier, unbeknownst to the participants, the investigator actually set the speed to match what each participant had self-selected during the first session. This included both the initial speed and any modifications the participants had made at 5-min intervals during the bout.

RESULTS

Intensity manipulation check

A 2(conditions: autonomous vs. controlled) by 7(time points: baseline, min 5, 10, 15, 20, 25, 30) ANOVA (with Greenhouse-Geisser adjustments of the degrees of freedom when sphericity was violated) for RPE showed only a significant main effect for time, $F(2.98, 53.61) = 13.01, p < .001, \text{partial } \eta^2 = .42$. The peak RPE was 10.21 ($SD = 2.35$) during the autonomous condition and 10.16 ± 2.63 during the controlled condition. These averages correspond to a rating of perceived exertion between 9 (very light) and 11 (fairly light).

A similar ANOVA for heart rate showed significant main effects for condition, $F(1, 18) = 15.19, p < .01, \text{partial } \eta^2 = .46$, and time, $F(1.95, 35.19) = 19.30, p < .001, \text{partial } \eta^2 = .52$. Perhaps due to increased familiarity with the laboratory environment and the experimental setup, the participants exhibited lower heart rates during the second (controlled) condition than during the autonomous condition (recall that treadmill speed was identical). Heart rate increased from baseline to min 20 and remained stable thereafter, until the end of both sessions: autonomous condition, from 92 ($SD = 2$) to 126 ($SD = 5$) beats/min; controlled condition, from 87 ($SD = 2$) to 120 ($SD = 4$) beats/min).

Perceived autonomy manipulation check

A repeated-measures multivariate analysis of variance (MANOVA) was conducted in order to examine whether the participants perceived the second condition as more controlled (less autonomous), as indexed by all three qualities of perceived autonomy (i.e., locus of causality, volition, perceived choice). The MANOVA showed a significant main effect of condition, Pillai's trace = .94, $F(3, 16) = 77.86, p < .001, \text{partial } \eta^2 = .94$. Univariate ANOVAs, presented in Table 1, showed significant decreases in all three qualities, as well as in the overall perception of autonomy score, from the autonomous to the controlled condition.

Self-efficacy manipulation check

A 2(conditions: autonomous vs. controlled) by 5(time points: baseline, min 5, 15, 25, post-bout) ANOVA for self-efficacy showed a significant main effect of condition, $F(1, 18) = 8.25, p < .01, \text{partial } \eta^2 = .31$, a significant main effect of time, $F(1.70, 30.56) = 8.48, p < .01, \text{partial } \eta^2 = .32$, as well as a significant condition

Table 1. Descriptive statistics (*M* and *SD*) and results of ANOVA for the scales of Perceived Autonomy and the Intrinsic Motivation Inventory as a function of condition

	Autonomous condition		Controlled Condition		<i>F</i> (1, 18)	partial η^2
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
Perceived autonomy						
Locus of causality	5.59	.99	4.24	1.48	29.68***	.62
Volition	6.07	.76	5.26	1.31	9.15*	.34
Perceived choice	6.82	.42	1.88	1.34	257.34***	.93
Autonomy (total)	6.16	.62	3.79	1.15	134.10***	.88
Intrinsic motivation						
Interest/Enjoyment	5.83	.91	5.51	1.08	4.53*	.20
Perceived choice	6.40	.66	5.42	1.21	15.82***	.47
Perceived competence	4.62	1.06	4.90	1.31	3.62, ns	.17
Value/Usefulness	6.40	.61	6.18	1.06	1.28, ns	.07

Note: * $p < .05$; *** $p < .001$.

by time interaction, $F(2.32, 41.78) = 8.72$, $p < .001$, partial $\eta^2 = .33$. The participants reported significantly higher self-efficacy scores at baseline during the second (controlled) condition ($M = 59.34\%$, $SD = 19.07$) than during the first (autonomous) condition ($M = 40.46\%$, $SD = 21.67$), $F(1, 18) = 16.51$, $p < .001$, partial $\eta^2 = .48$. While self-efficacy remained stable throughout the bout in the controlled condition (at min 30: $M = 61.51\%$, $SD = 21.41$), it gradually increased during the autonomous condition reaching a level that was not different than that during the controlled condition (by min 30: $M = 58.62\%$, $SD = 18.58$).

Intrinsic motivation

A repeated-measures MANOVA for the factors of IMI (i.e., Interest/Enjoyment, Perceived Choice, Perceived Competence, and Value/Usefulness) showed a significant main effect of condition, Pillai's trace = .55, $F(4, 15) = 4.51$, $p < .05$, partial $\eta^2 = .55$. The multivariate effect was due to significant differences between the autonomous and the controlled conditions for Interest/Enjoyment and Perceived Choice but not for Perceived Competence and Value/Usefulness factors (Table 1). The participants' Interest/Enjoyment and Perceived Choice scores were significantly lower after the controlled condition than after the autonomous condition.

Affect

An initial comparison of baseline levels of Energetic Arousal and Tense Arousal showed no significant differences between the autonomous and controlled condi-

tions. The 2(conditions) by 2(pre-bout, post-bout) ANOVA for Energetic Arousal showed a significant main effect of time, $F(1, 18) = 21.57, p < .001$, partial $\eta^2 = .54$, and a significant Condition by Pre/Post interaction, $F(1, 18) = 5.95, p < .05$, partial $\eta^2 = .25$ (Table 2). Energetic Arousal increased significantly in both the autonomous condition, $F(1, 18) = 19.62, p < .001$, partial $\eta^2 = .52$, and in the controlled condition, $F(1, 18) = 13.16, p < .01$, partial $\eta^2 = .42$. However, the change from the pre-bout to the post-bout was significantly larger, $F(1, 18) = 5.95, p < .05$, partial $\eta^2 = .25$, in the autonomous ($M = 7.37, SD = 7.25$) compared to the controlled ($M = 3.95, SD = 4.74$) condition. There were no significant effects for Tense Arousal. Likewise, a 2(conditions) by 7(time points: baseline, min 5, 10, 15, 20, 25, 30) ANOVA on the FS data showed no significant effects, $F(2.03, 36.47) = 0.88, ns$.

Table 2. Descriptive statistics (M and SD) for the Energetic Arousal and Tense Arousal scales of the Activation Deactivation Adjective Check List (ADACL) as a function of condition

	Autonomous condition		Controlled Condition	
	M	SD	M	SD
Pre-bout				
Perceived autonomy	24.32	5.81	26.16	6.05
Intrinsic motivation	20.16	6.68	19.10	3.54
Post-bout				
Perceived autonomy	31.68	5.02	30.10	6.12
Intrinsic motivation	20.95	4.07	21.26	3.54

DISCUSSION

Evidence is now emerging in the context of physical activity that supports what hedonic theorists of motivation have been arguing for millennia and what many practitioners have known for years: in the long run, people are less likely to pursue activities that make them feel worse or activities that, although pleasant, cannot compete successfully with other, more pleasant alternatives (Kiviniemi et al., 2007; Williams et al., 2008). Because Greeks have been said to exhibit a characteristically "hedonistic" approach to life in general, allowing the pursuit of pleasure to take precedence over other considerations (Mamalakis et al., 2000), it is possible that the hedonic perspective on motivation might be especially relevant in this population.

In light of the new evidence implicating affective responses to physical activity in motivation for future participation, it is becoming increasingly clear that the opti-

mization of affective responses should be taken into account when recommending or prescribing physical activity to the public. It is, thus, interesting to examine how physical activity is portrayed in the popular media (which, presumably, have a much stronger impact on public perception and behavior than arcane scientific publications). According to a highly influential best-selling book (Greene, 2002), people should exercise «at the highest intensity that is safe» (p. 108). Physical activity and health professionals are cautioned that «when most people are left to their own devices, they will adopt an exercise intensity that is too low» (p. 109) and, therefore, they should push people harder. According to the same source, the appropriate intensity of physical activity is one that induces «a definite feeling of fatigue» (p. 113) and takes people «past [their] level of comfort» (p. 115).

It is, of course, futile to seek what the scientific basis of these claims could be, as they seem to go directly against the current scientific consensus. Nevertheless, it is doubtful that this lack of supporting evidence has diminished their impact on people's perceptions of what constitutes "adequate" or "worthwhile" physical activity. Particularly disconcerting is the claim that «when most people are left to their own devices, they will adopt an exercise intensity that is too low» (Greene, 2002, p. 109). The clear implication is that "most people" must be pushed harder by their personal trainer, exercise leader, or cardiac rehabilitation specialist. This is a proposition that is directly relevant to the postulates of SDT and the purpose of the present study.

Every piece of evidence available in the literature suggests that "when most people are left to their own devices" they select an intensity of physical activity that is well within what is recommended by the American College of Sports Medicine (ACSM, 2006) for the development and maintenance of cardiorespiratory fitness and/or health. Specifically, the ACSM recommends that physical activity be performed within a range of intensity that extends between a low of 40-50% of oxygen uptake reserve (VO_2R) or heart rate reserve (HRR) or 64-70% of maximal heart rate (HRmax) and a high of 85% VO_2R or HRR or 94% HRmax. The results from both middle-aged adults (Lind, Joens-Matre, & Ekkekakis, 2005; Murtagh, Boreham, & Murphy, 2002; Spelman, Pate, Macera, & Ward, 1993) and college-age participants (Dishman, Farquhar, & Cureton, 1994; Focht & Hausenblas, 2003; Parfitt et al., 2000; Pintar, Robertson, Kriska, Nagle, & Goss, 2006) consistently show that self-selected intensity is within these margins.

In the present study, when the women were asked to choose their own intensity (i.e., in the autonomous condition), they averaged 67% ($SD = 13$) of age-predicted HRmax. This level of intensity is within the ACSM-recommended range, albeit near the low end of the range (i.e., 64% to 70% HRmax), and is entirely

consistent with previous data from similar samples (Focht & Hausenblas, 2003; Pintar et al., 2002).

Contrary to these results, when participants are prompted to walk “briskly”, or “fast”, or “as quickly as possible”, the intensity has been found to rise to levels near or above the maximum recommended by the ACSM (Fitzsimons et al., 2005; Hills, Byrne, Wearing, & Armstrong, 2006; Murtagh et al., 2002). In one of these studies, the self-selected walking speed was 1.60 m/s while the speed the participants adopted when verbally prompted to walk “briskly” as per the term used to describe the appropriate walking pace in some physical activity recommendations was 1.86 m/s (Murtagh et al., 2002). Is a discrepancy of approximately 20 cm/s likely to have any appreciable effects? As noted in the introduction of the present article, a recent study examined a similar scenario, in which the treadmill speed was set by the experimenter at a level just 10% higher than what each participant had self-selected during a previous session (Lind et al., 2008). Interestingly, both the self-selected (1.64 m/s) and the imposed treadmill speeds (1.80 m/s) were nearly identical to those observed in the Murtagh et al. (2002) study. Lind et al. (2008) reported that even such a minor acceleration is sufficient to induce a significant, moderate-size decline in ratings of pleasure (effect size $d = -.53$).

The present study was conceived as a follow-up to the study by Lind et al. (2008) and was specifically designed to establish the distinct role of perceived loss of autonomy. To our knowledge, this was also the first experimental study to examine the causal effect of changes in perceptions of autonomy on affective responses in the context of physical activity. The manipulation checks showed the following. First, although there was a small (approximately 5 beats/min) difference between the autonomous and controlled conditions in heart rate (the controlled condition being lower), there was no difference in perceived exertion. Therefore, it is unlikely that any differences in affective responses in favor of the autonomous condition could be attributed to differences in intensity. Second, the transition from the autonomous to the controlled condition did not lower the participants' level of self-efficacy. In fact, the women reported higher baseline levels of efficacy in the controlled than in the autonomous condition, perhaps due to their positive previous experience (consistent with social-cognitive theory postulates) or due to their increased familiarity with the laboratory and the experimental setup during their second visit. Thus, again, any differences in affective responses in favor of the autonomous condition could not be attributed to differences in self-efficacy. Third, the manipulation was apparently highly effective, since the controlled condition resulted in significant decreases in locus of causality, volition, perceived choice, and the perceived autonomy composite score.

The hypothesis of enhanced intrinsic motivation and affect in the autonomous compared to the controlled condition was generally supported. Specifically, the results showed that the participants gave significantly higher scores in Interest/Enjoyment and Perceived Choice after the autonomous than after the controlled condition, indicating a higher degree of intrinsic motivation. This was also accompanied by a larger improvement in Energetic Arousal in the autonomous condition. On the other hand, there was no effect on the broad affective dimension of pleasure-displeasure.

These results are consistent with those of experimental studies conducted in educational settings, which have shown that non-autonomous conditions are typically associated with less positive affective states compared to autonomous conditions (Black & Deci, 2000; Nix et al., 1999). Moreover, our findings agree with those of Nix et al. (1999) in that the effects of the autonomy manipulation were specific to a measure of energy (i.e., the Energetic Arousal scale of AD ACL) and did not extend to the dimension of affective valence (pleasure-displeasure). This seems to support the argument forwarded by Nix et al. (1999) that feelings of energy and vitality constitute a key characteristic of autonomously regulated, eudaimonic pursuits.

It is also noteworthy that, in the present study, changes in perceptions of autonomy influenced affective responses (energy and enjoyment) but did not have an effect on perceived competence. This can be attributed to the fact that the task involved (i.e., treadmill activity) did not have an explicit evaluative component and did not entail success or failure (i.e., the participants could not compare themselves to others since they exercised individually and the investigator was careful to not create the impression that there were any specific performance expectations). Thus, it is unlikely that the participants' sense of control was significantly challenged. As Patrick, Skinner, and Connell (1993) have suggested, perceived competence is strongly related to perceived control. The same researchers have noted that perceived competence may not be influenced by changes in autonomy to the same degree as affect and enjoyment are.

In interpreting the results of the present study, researchers and practitioners should take into account its inherent limitations. First among those are the limitations associated with the sample, which was both small and narrow in terms of representativeness (including only college women). Second, one should not assume that the present results necessarily generalize to other modes of activity (e.g., cycling or swimming) or to bouts of activity of different duration. Third, by necessity, the experimental design was not counterbalanced. In other words, since we wanted to control for intensity, we had to first conduct a session at self-selected intensity and then to conduct a "controlled" session at intensity that

matched the self-selected. This obviously precludes counterbalancing, thus raising the possibility of order effects. In this particular case, we did observe differences between the first (autonomous) and second (controlled) conditions in some variables, such as heart rate and baseline self-efficacy, but, fortunately, not in any of the dependent variables. In future studies employing a similar experimental protocol, we recommend the use of an initial familiarization session as a means of preventing problems associated with order effects.

In conclusion, the present study demonstrated that the simple action of setting an individual's level of physical activity for her, instead of allowing her to select it herself, can lower the individual's sense of autonomy (i.e., perceived internal locus of causality, freedom of volition, and perceived choice) and, in turn, lessen the degree of energy and enjoyment that the individual derives from her physical activity participation. Importantly, this can happen even in the absence of differences in the perceived intensity of physical activity and any negative impact on the individual's sense of self-efficacy and perceived competence. In other words, it is reasonable to deduce that the culprit is, specifically, the loss of perceived autonomy, as would be predicted by the self-determination theory. In light of the emerging role of affective responses to physical activity in long-term adherence (Kiviniemi et al., 2007; Williams et al., 2008), we submit that the present data offer a unique, albeit preliminary, piece of evidence in support of recent arguments for incorporating psychological considerations in the rationale underpinning physical activity prescription guidelines. More specifically, a reasonably strong case can now be made for the promotion of self-paced physical activity in the domain of public health. Overwhelmingly, the available evidence suggests that, when people exercise for health and/or fitness, most do, in fact, select a level of intensity that is conducive to meaningful physiological adaptations, as per current ACSM (2006) standards. On the contrary, even minor deviations from self-selected levels of intensity can both raise intensity to unnecessarily high (and potentially dangerous) levels and have a detrimental effect on the quality of the affective experience that the individuals derive. What the present study adds is that, even when the imposed intensity does not differ from the self-selected level, there is a significant impact on the quality of the affective experience, with possible long-term implications for adherence.

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