

# The Affective Impact of Exercise Intensity That Slightly Exceeds the Preferred Level

## 'Pain' for No Additional 'Gain'

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### Abstract

We examined the affective consequences of an exercise intensity that slightly exceeded the preferred level. Twenty-five middle-age sedentary women participated in two 20-min treadmill exercise bouts, one during which they could select the speed and one during which the speed was 10 per cent higher than the self-selected. During the bout at self-selected intensity, ratings of pleasure remained stable, whereas during the imposed-intensity bout pleasure decreased. Therefore, even a minor increase in exercise intensity beyond the level that a new exerciser would have self-selected can bring about a decrease in pleasure. Over time, such experiences could lower adherence.

### Keywords

- *adherence*
- *pleasure*
- *self-determination*
- *ventilatory threshold*

PHYSICAL inactivity represents a major challenge for public health. Studies have shown that exercise intensity is negatively related to both pleasure (Ekkekakis & Petruzzello, 1999) and adherence (Cox, Burke, Gorely, Beilin, & Puddey, 2003; Lee et al., 1996; Perri et al., 2002). Therefore, high intensities, which are common among beginners hampered by high body weight and low fitness, might be unpleasant and, in turn, such experiences could reduce the motivation for continued participation. In an effort to understand better the intensity–affect relationship, the present study simulated a hypothetical scenario: what would happen if an exercise professional set an intensity slightly higher than what a new exerciser would have self-selected?

The rationale was twofold. First, we expected that participants would select an intensity close to their ventilatory threshold (Dishman, Farquhar, & Cureton, 1994; Lind, Joens-Matre, & Ekkekakis, 2005), allowing them to maintain a stable, pleasant affective state. On the other hand, an intensity even slightly higher than the self-selected would push participants over the threshold, inducing a decrease in pleasure (Acevedo, Kraemer, Haltom, & Tryniecki, 2003; Bixby, Spalding, & Hatfield, 2001; Ekkekakis, Hall, & Petruzzello, 2004). Second, based on self-determination theory (Deci & Ryan, 2000), we expected that the pleasure that individuals would experience when their behaviour was externally controlled (when intensity was imposed) would be lower than when acting autonomously (when they could control their intensity).

Previous studies comparing self-selected and imposed intensities not specifically chosen to be higher than the self-selected have yielded equivocal results (Farrell, Gates, Maksud, & Morgan, 1982; Focht & Hausenblas, 2003; Parfitt, Rose, & Burgess, 2006; Parfitt, Rose, & Markland, 2000). In this study, we compared the affective responses to a self-selected intensity with those to an intensity slightly higher (10 per cent of treadmill speed) than the self-selected.

## Methods

### Participants

Twenty-five women consented to participate (mean age  $\pm$  SD = 43.68  $\pm$  4.83 years; mean body mass = 78.37  $\pm$  16.98 kg; mean height = 166.27  $\pm$  6.35 cm; mean body mass index = 28.03  $\pm$  6.25 kg·m<sup>-2</sup>; mean

maximal oxygen uptake = 22.98  $\pm$  5.69 ml·kg<sup>-1</sup>·min<sup>-1</sup>). They were screened to ensure that they had been sedentary (< 30 minutes of daily moderate physical activity) for at least 12 months and were apparently healthy.

### Measures

Heart rate was assessed with a heart rate monitor (Polar, Finland). Oxygen uptake was assessed with a computerized system (TrueMax 2400, ParvoMedics, Salt Lake City, UT). Blood lactate was assessed with an Accutrend-Lactate analyser (Roche Diagnostics, Indianapolis, IN). Perceived exertion was assessed with the 15-point Rating of Perceived Exertion (RPE; Borg, 1998).

Affective responses were assessed on the basis of the circumplex model (Ekkekakis & Petruzzello, 2002), according to which affect is defined by the dimensions of affective valence (pleasure–displeasure) and perceived activation. Valence was assessed with the Feeling Scale (FS; Hardy & Rejeski, 1989). The FS is an 11-point rating scale ranging from +5 to –5, with anchors at zero ('Neutral') and at all odd integers, from 'Very Good' (+5) to 'Very Bad' (–5). Activation was assessed by the Felt Arousal Scale (FAS; Svebak & Murgatroyd, 1985), a six-point rating scale from 1 to 6, with anchors at 1 ('Low Arousal') and 6 ('High Arousal').

### Procedures

There were three laboratory sessions, with a minimum of 48 hours between them (mean  $\pm$  SD = 8.23  $\pm$  4.31 days between the first and second and 7.00  $\pm$  4.77 days between the second and third). To control for diurnal effects, all sessions were scheduled at the same time of day for each participant. The first session involved an incremental treadmill test to volitional exhaustion, to determine peak oxygen uptake (VO<sub>2peak</sub>), peak heart rate (HR<sub>peak</sub>) and the ventilatory threshold (determined with a computerized version of the procedure of Gaskell et al., 2001).

For the second session, the women were told that they were to engage in a 20-minute bout of treadmill exercise, during which they would be able to set the speed (the grade was kept at 0 per cent). No reference to an exact modality (walk, jog, run) was made. Participants responded to the FS and FAS and were then fitted with the heart rate monitor and a face mask for the collection of expired gases (Hans Rudolph, Kansas City, MO). They were then allowed to warm

up for five minutes ( $1.11 \text{ m}\cdot\text{s}^{-1}$ , 0% grade). After the warm-up, each participant set the speed that she wanted (0.00 min) and was allowed to make adjustments (faster or slower) every five minutes (min 5.00, 10.00, 15.00). RPE, FS and FAS ratings were obtained at min 0.00 (end of the warm-up), 4.45, 9.45, 14.45 and 19.45 by asking participants to indicate their responses on a poster-size version of the scales. At 20.00, the treadmill was stopped and a droplet of blood was obtained by a finger prick for the assessment of blood lactate. Following this interruption, the participants cooled down for five minutes ( $1.11 \text{ m}\cdot\text{s}^{-1}$ , 0% grade). This was followed by 20 minutes of seated recovery. An identical procedure was followed during the third session, with the exception that the speed of the treadmill was adjusted by the experimenters (at 0.00, 5.00, 10.00 and 15.00) to be 10 per cent higher than what the participants had selected at the corresponding time point during the second session.

## Results

### Intensity manipulation checks

The 2 (intensity conditions) by 5 (time: end of warm-up, min 5, 10, 15, 20) repeated-measures ANOVA (with Greenhouse-Geisser adjustment of the degrees of freedom when sphericity was violated) for %HR<sub>peak</sub> showed significant condition and time main effects, superseded by a significant condition by time interaction,  $F(2.51, 47.72) = 10.97, p < .001, \eta^2 = .37$ . Based on least-significant-difference contrasts, the two conditions differed significantly at min 10, 15 and 20 ( $91.14 \pm 13.83\%$  versus  $84.17 \pm 12.86\%$  at min 20). A similar ANOVA for the %VO<sub>2</sub> at the ventilatory threshold showed significant condition and time main effects superseded by a significant condition by time interaction,  $F(2.61, 54.84) = 23.45, p < .001, \eta^2 = .53$ . The intensity conditions differed significantly at min 5, 10, 15 and 20 ( $115.40 \pm 31.04\%$  versus  $98.07 \pm 24.79\%$  at min 20). A *t*-test for blood lactate was also significant,  $t(22), 3.26, p < .01$  ( $4.80 \pm 3.10$  versus  $3.14 \pm 1.57 \text{ mmol}\cdot\text{L}^{-1}$ ). Finally, the ANOVA for RPE showed significant main effects of condition and time, superseded by a condition by time interaction,  $F(2.21, 46.41) = 14.43, p < .001, \eta^2 = .41$ . RPE differed significantly at min 10, 15 and 20 ( $14.92 \pm 2.47$  versus  $13.72 \pm .90$  at min 20).

### Affective responses

The 2 (intensity conditions) by 6 (time points: base-line, end of warm-up, min 5, 10, 15, 20) ANOVA for FS showed a condition by time interaction,

$F(2.90, 69.71) = 3.70, p < .05, \eta^2 = .13$ . ANOVAs within each condition showed that the FS did not change significantly in the self-selected-intensity condition but did change in the imposed-intensity condition,  $F(5, 120) = 2.45, p < .05, \eta^2 = .09$ . Compared to pre-exercise, FS was significantly lower in the imposed-intensity condition at min 5 and 15. The decline was continuous, albeit of small to medium magnitude (compared to pre-exercise), with effect sizes ( $d = (M_i - M_j)/SD_{\text{pooled}}$ ) of  $d = -.08, -.25, -.45, -.41$  and  $-.53$  at the end of warm-up and min 5, 10, 15 and 20, respectively.

A similar ANOVA for FAS showed a significant main effect of time,  $F(2.44, 58.43) = 23.47, p < .001, \eta^2 = .49$ , and a significant condition by time interaction,  $F(5, 120) = 2.22, p = .05, \eta^2 = .09$ . FAS increased significantly in both the self-selected-intensity condition,  $F(5, 120) = 11.53, p < .001, \eta^2 = .32$ ; and in the imposed-intensity condition,  $F(5, 120) = 24.54, p < .001, \eta^2 = .51$ . In the self-selected-intensity condition, the increase from base-line was significant at min 10, 15 and 20 ( $d = .64, .88, .90$ , respectively), whereas, in the imposed-intensity condition, the increase was significant at min 5, 10, 15 and 20 ( $d = .56, .81, 1.22, 1.33$ , respectively). The two conditions differed significantly at min 10, 15 and 20.

## Discussion

The main finding of this study was that even a minor increase in exercise intensity beyond the self-selected level can bring about a decrease in pleasure. We expected that, when allowed to choose their intensity, the participants would, on average, select an intensity approximating their ventilatory or lactate threshold and this would allow them to maintain a stable and pleasant affective state. As expected, on average, the participants selected an intensity close to the ventilatory threshold (oxygen uptake of  $98.07 \pm 24.79$  per cent of the ventilatory threshold). Furthermore, average blood lactate, at  $3.14 \pm 1.57 \text{ mmol}\cdot\text{L}^{-1}$ , was under the  $4.0 \text{ mmol}\cdot\text{L}^{-1}$  level commonly considered the hallmark of blood lactate accumulation. On the other hand, we expected that, when the intensity was set to be higher than the self-selected, affect would decline, presumably due to having exceeded the ventilatory or lactate threshold and having a reduced sense of autonomy. Indeed, oxygen uptake reached  $115.40 \pm 31.04$  per cent of the ventilatory threshold, blood lactate was raised to  $4.80 \pm 3.10 \text{ mmol}\cdot\text{L}^{-1}$ , and

pleasure showed a medium-size drop. We believe that, by raising the treadmill speed by just 10 per cent, we 'tipped' the participants over the fine line that allowed them to maintain both a physiological and an affective steady-state.

Importantly, the average intensity selected by the women in this sample ( $84.17 \pm 12.86\%$  HRpeak at min 20) was near the high end of the range recommended by the American College of Sports Medicine (2006) for the development and maintenance of cardiorespiratory fitness. When the speed was imposed, the average intensity reached the high limit of the recommended range ( $91.14 \pm 13.83\%$  HRpeak). Moreover, in studies of previously sedentary adults, intensities proximal to and higher than the ventilatory or lactate thresholds yielded similar fitness benefits (e.g. Belman & Gaesser, 1991; Casaburi, Storer, Sullivan, & Wasserman, 1995; Weltman et al., 1992). In other words, in this population, an intensity that exceeds these thresholds, although likely to induce affective declines, might not result in added fitness benefits (i.e. 'pain' might not result in added 'gain').

The scenario we simulated seems realistic. The self-selected treadmill speed in this study reached  $1.65 \pm .40 \text{ m}\cdot\text{s}^{-1}$  ( $3.72 \pm .90 \text{ mph}$ ), so the increase in speed beyond the self-selected level was  $< .20 \text{ m}\cdot\text{s}^{-1}$  (approximately .40 mph or 7 per cent HRpeak). In a previous study of women of similar age ( $40.20 \pm 13.30$  years) but higher fitness ( $31.60 \pm 7.30 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ ) and lower body mass index ( $24.40 \pm 3.50 \text{ kg}\cdot\text{m}^{-2}$ ), the self-selected treadmill speed ( $1.60 \pm .24 \text{ m}\cdot\text{s}^{-1}$ ) and that adopted when participants were prompted to walk 'briskly' ( $1.86 \pm .12 \text{ m}\cdot\text{s}^{-1}$ ), consistent with the language in physical activity recommendations, were almost identical (within  $.05 \text{ m}\cdot\text{s}^{-1}$ ) to those in the present study (Murtagh, Boreham, & Murphy, 2002). Studies with different samples have also shown that, although self-selected intensities are generally within recommended limits, prompting participants to walk 'fast' or 'as quickly as possible' results in excessively high intensities (Fitzsimons et al., 2005; Hills, Byrne, Wearing, & Armstrong, 2006; Spelman, Pate, Macera, & Ward, 1993).

The results of this study cannot be assumed to generalize to samples with different characteristics (e.g. men, younger or older participants or patients with exercise-limiting conditions) or to different exercise stimuli (e.g. modality or duration) without further study. Furthermore, given that counterbalancing the conditions was not possible (the

imposed-intensity condition had to follow the self-selected one), there might have been an order effect. Pre-exercise FS scores were higher in the third session ( $2.92 \pm 1.04$ ) than the second ( $2.48 \pm 1.19$ ), although not to a statistically significant degree. Not having to disclose the procedures to be followed during each of the sessions in advance could preclude an anticipatory response. However, this was not permitted by the Institutional Review Board that approved the experimental procedures. Finally, a question that remains to be answered is whether the decrease in pleasure when the intensity is imposed is due to the added physiological strain, the loss of autonomy or both.

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