Perceptual and cognitive responses during exercise: Relationships with metamotivational state and dominance

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Abstract
In this study, we examined ratings of perceived exertion (RPE) and attentional focus during exercise in relation to telic and paratelic metamotivational dominance and state. Thirty regular exercisers (11 females, 19 males), of whom 10 were telic dominant (mean Paratelic Dominance Scale score = 6.2 ± 2.9), 10 paratelic dominant (mean PDS score = 23.8 ± 1.4), and 10 non-dominant (mean PDS score = 15.4 ± 0.7) completed two exercise trials. In the first trial, the participants completed a maximal ramped exercise test on a motorized treadmill to determine their gas exchange threshold (the speed at which determined exercise intensity of the subsequent trial). Throughout the second trial (a 30-min treadmill run), the participants reported their metamotivational state, RPE, and attentional focus (associative or dissociative) at 5-min intervals. Heart rate was recorded at 3, 8, 13, 18, 23, and 28 min and expired air was analysed for oxygen consumption (VO2) between 1, 3, 6, 8, 11, 13, 16, 18, 21, 23, and 26–28 min. There was no main effect of dominance or dominance × time interaction on any variables (P > 0.05). Oxygen consumption did not differ between states but RPE was higher in the telic than paratelic state at 25 and 30 min (t28 = 2.87, P < 0.05; t26.77 = 3.88, P < 0.05, respectively). Attentional focus was more associative in the telic than paratelic state at 20, 25, and 30 min (t28 = −2.73, P < 0.05; t28 = −4.85, P < 0.01; t28 = −5.15, P < 0.05, respectively) and heart rate was higher at 23 min in the telic state (t27 = 3.40, P < 0.05). During the latter stages of exercise, the telic metamotivational state, not dominance, was related to a more associative attentional focus and higher RPE. Our results support the use of reversal theory (Apter, 2001) to understand perceptual and cognitive responses during aerobic exercise, but an experimental design in which state is manipulated is needed to examine the effects of metamotivational dominance and state on perceptual and cognitive responses.

Keywords: Attention style, reversal theory, rating of perceived exertion, aerobic exercise

Introduction
Morgan and Pollock (1977) introduced the notion that attentional focus may vary during aerobic exercise and identified an associative focus as attention directed towards the physical sensations associated with exercise and a dissociative focus as attention centred on distractions from the exercise. They suggested that the latter “turns off” the athlete’s “perceptostat” (where current and past perceptions and sensory information are integrated) and the former turns it on, affecting the athlete’s perception of effort during aerobic exercise. Studies have subsequently demonstrated that a dissociative focus is related to lower effort perceptions during exercise (e.g. Baden, Warwick-Evans, & Lakomy, 2004), commonly measured as ratings of perceived exertion (RPE: Borg, 1973).

As exercise duration or intensity increases, attentional focus becomes more associative, accompanied, as one would expect, by an increase in RPE (e.g. Baden, McLean, Tucker, Noakes, & St. Clair Gibson, 2005; Tenenbaum & Connolly, 2008). Regarding expected exercise duration, results are less conclusive. Baden et al. (2004) reported more associative thoughts in club runners during a short (8 miles) compared with a long (10 miles) cross-country run. Baden and colleagues (2005) also observed a more associative attentional focus...
between 10 and 11 min during a 20-min treadmill run in club runners who expected to run for 10 min, compared with an expected duration of 20 min and an unknown duration. In contrast, different expected durations did not affect attentional focus in sports students and exercise referral completers who ran on a treadmill for 10 min (Baden et al., 2004).

Thus situational (exercise intensity and duration) and perceptual factors (RPE, and, to some degree, expected exercise duration) are related to attentional focus during exercise. The person factors of gender and experience have also been examined in relation to attentional focus, although no gender- or experience-related differences in performance have been revealed when using either an associative or disassociative focus (Connolly & Janelle, 2003; Tenenbaum & Connolly, 2008).

Research into person factors within this context is limited. However, Ekkekakis (2008) has stressed the importance of inter-individual variability when examining affective responses to exercise, as the affective response to moderate-intensity exercise differs between individuals (Ekkekakis, Hall, & Petruzzello, 2005; Ekkekakis, Thome, Petruzzello, & Hall, 2008). This is partly because individuals differ in their preferred and tolerated exercise intensities; these preferences are influenced by dispositional and situational factors, although research has not fully explored and identified these variables (Legrand, Bertucci, & Thatcher, 2009). Similarly, a consideration of inter- and intra-individual factors in relation to attentional focus and RPE might provide us with a more comprehensive understanding of these cognitive and perceptual responses during exercise. Given the potential number of person factors that could be examined, a theoretical framework to guide their selection is important.

Reversal theory (Apter, 1982) incorporates dispositional (termed dominance in reversal theory) and situational (state) person factors, rendering it particularly suited to an exercise context, where the individual’s perceptions and cognitions may change throughout exercise. Reversal theory postulates four pairs of metamotivational states, or ways of interpreting current needs and motives: (a) telic–paratelic, (b) autic–alloic, (c) mastery–sympathy, and (d) negativist–conformist (Apter, 2001). In the telic state, individuals are motivated to engage in serious, purposeful pursuits with meaningful future consequences and have a preference for low levels of arousal. In the paratelic state, the individual prefers to engage in spontaneous activities that have no meaningful or long-term purpose or consequence and to experience high arousal (Apter, 2001). This study focuses on the telic–paratelic pair, as has most sport and exercise research, which has demonstrated the pair’s relevance in this context (e.g. Kerr & van den Wollenberg, 1997). Explanations of the remaining states are therefore not provided here but can be found in Apter (2001). The importance of a theoretical underpinning to research was emphasized most colourfully by Forscher (1963). He suggested that research without an underpinning theory is analogous to building without foundations, resulting in an unstable and random construction of bricks (data). Underpinning theory, however, directs the research process and results in more convincing and predictable findings.

According to reversal theory, current state is more important in influencing our phenomenological experience than behaviour or context. Thus individuals can experience the same behaviour in different ways, depending on which state is operative. States within each pair are mutually exclusive, hence when in a telic state an individual cannot also be in a paratelic state but can reverse between different states within a pair (Apter, 2001). Each individual has a propensity to spend more time in one state from each pair, known as dominance, and therefore individuals can be telic or paratelic dominant. Motivational dominance and state represent different ways of interpreting aspects of experience that are concerned with motivation, meaning, and arousal, offering a framework for thoughts, actions, and perceptions and making them particularly suitable person factors to examine in the current study (Apter, 2001).

Telic and paratelic dominance are related to sport participation, with telic-dominant individuals preferring safe, endurance-based sports and paratelic-dominant individuals preferring explosive, risky sports (e.g. Cogan & Brown, 1999). Based on these exercise preferences, it is likely that paratelic-dominant individuals will adopt a more dissociative focus during aerobic exercise to disengage from the activity and telic-dominant individuals are likely to adopt an associative focus to extract something meaningful from their experience. Comparable relationships between metamotivational state and attentional focus are likely regardless of dominance, if state exerts a more influential role than dominance.

These exercise preferences also reflect telic- and paratelic-dominant individuals’ respective preferences for low and high felt arousal, as demonstrated by Martin and colleagues (Martin, Kuiper, Olinger, & Dobbin, 1987). Paratelic-dominant individuals interpreted highly arousing situations (e.g. unresolved problems) as challenging, whereas telic-dominant individuals interpreted such highly arousing situations as stressful. Correspondingly, Perkins and colleagues (Perkins, Wilson, & Kerr, 2001) demonstrated that athletes who were experimentally induced into the telic and paratelic states expressed a preference for low and high arousal, respectively.
Kerr and van den Wollenberg (1997) observed increases in arousal and stress during high-intensity running, alongside a more telic orientation. Although they did not measure preferred arousal, this stress response may reflect undesired high arousal in the telic state. It is likely, then, that when exercising at high intensity in the telic state the high arousal this induces will be interpreted negatively and RPE will be higher compared with when exercising in the paratelic state. In this state, high arousal is likely to be interpreted positively and RPE to be lower.

In support of this proposal, Dishman and colleagues (Dishman, Farquhar, & Cureton, 1994) demonstrated that at preferred exercise intensities, RPE responses do not necessarily reflect indicators of relative metabolic intensity. From a reversal theory perspective, this suggests that in the telic state high arousal experienced due to exercise will result in higher stress and higher RPE. In contrast, in the paratelic state, with a preference for high arousal, stress will be lower, as will RPE. With constant-pace exercise, as used in the current study, it is likely that these effects will be seen only in the later stages of exercise when exercise duration has resulted in the need to work harder and therefore produce higher arousal in participants.

A comparable pattern of responses may be evident in relation to dominance, as telic-dominant individuals are likely to adopt an associative attentional focus, which has previously been related to a higher RPE (e.g. Baden et al., 2004). Telic-dominant individuals’ preference for endurance activities may, however, act as a confounding factor here as their endurance experience and training may lead to lower RPE due to greater familiarity with aerobic exercise compared with paratelic-dominant individuals. In support of this explanation, Parfitt and Gledhill (2004) identified that RPE was lower during high-preferred versus low-preferred aerobic exercise in low-active adults.

Given the need to investigate person factors that may influence RPE and attentional focus during exercise, here we examine two main research questions: (1) Do RPE and attentional focus differ during aerobic exercise in relation to metamotivational dominance? (2) Do RPE and attentional focus differ during aerobic exercise in relation to metamotivational state? Results are conflicting concerning whether dominance or state exerts most influence on individuals’ psychological and physiological responses. Some studies have demonstrated that dominance is more influential (e.g. Braathen & Svebak, 1990), while others have demonstrated that state exerts greater influence (e.g. Svebak, Storfjell, & Dalen, 1982). However, it was hypothesized that RPE and attentional focus will differ in relation to dominance (hypothesis 1). No hypothesis was forwarded concerning the direction of these expected differences, as opposing but equally viable potential relationships exist between these variables. It was also hypothesized that at the later stages of aerobic exercise, RPE will be higher and attentional focus more associative in the telic compared with the paratelic state (hypothesis 2).

As individuals prefer to spend more time in the state that matches their dominance, a subsidiary question was also examined: During aerobic exercise, do telic-dominant individuals spend more time in the telic state and paratelic-dominant individuals in the paratelic state? Only one previous exercise-based study included non-dominants (Bindarwish & Tenenbaum, 2006), thus this group was included in the current study. It was hypothesized that telic-dominant individuals will spend more time in the telic state and paratelic-dominant individuals in the paratelic state (hypothesis 3). No hypothesis was forwarded for non-dominants.

Methods

Participants
The participants were 30 healthy volunteers purposefully sampled from 150 respondents who completed the Paratelic Dominance Scale (PDS: Cook & Gerkovich, 1993; see Measures section; mean PDS score = 16.1 + 5.7). They ranged in age from 18.8 to 39.8 years (mean ± s: 22.6 ± 4.9 years) and participated 1–7 times per week in a range of sport and exercise activities. Ten participants were telic dominant (mean PDS score = 6.2 ± 2.9; 5 females and 5 males), 10 paratelic dominant (mean PDS score = 23.8 ± 1.4; 5 females and 5 males), and 10 non-dominant (mean PDS score = 15.4 ± 0.7; 1 female and 9 males). Telic dominance was classified as one standard deviation above the overall sample mean (21.76) and paratelic dominance as one standard deviation below the overall sample mean (10.34) (see Gerkovich, Cook, Hoffman, & O’Connell, 1998). Non-dominance was classified as scores from 15 to 16.

Measures

Metamotivational state (telic–paratelic). Metamotivational state was assessed using item 1 from the Telic State Measure (TSM: Svebak & Murgatroyd, 1985), which includes a 6-point Likert scale anchored by 1 (serious) and 6 (playful).

Attentional focus. Attentional focus was assessed based on Baden and colleagues’ (2004) protocol. Participants indicated their attentional focus using a
visual analogue scale anchored by the descriptors “associative” and “dissociative”. Scores on this scale ranged from −100 (totally associative) through 0 (equal mixture of associative and dissociative) to +100 (totally dissociative).

RPE. Rating of perceived exertion was assessed using Borg’s (1973) RPE scale, which ranges from 6 (no exertion at all) to 20 (maximal exertion). The scale’s reliability and validity have previously been demonstrated (Skinner, Hutsler, Bergsteinova, & Buskirk, 1973).

Metamotivational dominance. Metamotivational dominance was assessed using the Paratelic Dominance Scale, which consists of three 10-item subscales: playfulness, spontaneity, and arousal-seeking. Items are phrased to reflect paratelic dominance with a true/false response format. True responses are scored 1 and false responses are scored 0, producing a range of 0–30 for the overall scale. The convergent, discriminant, and construct validity of the PDS have been demonstrated (Apter & Deselles, 2001; Cook & Gerkovich, 1993), as has its internal consistency (α = 0.87 and 0.86 for odd and even numbered items, respectively; Cook & Gerkovich, 1993).

Procedures

Approval for this study was granted by the Ethics Committee of Aberystwyth University. Participants who met the dominance criteria were recruited verbally or via email and attended the laboratory on two occasions at least 24 h apart (apart from a sub-sample of six participants who attended on a third occasion; see below).

Visit 1. Participants provided informed consent and completed a Physical Activity Readiness Questionnaire (PAR-Q) prior to performance of a ramped treadmill exercise test to determine their gas exchange threshold. The ramped test was performed on a motorized treadmill (PPS 55med, Woodway GmbH, Weil an Rhein, Germany) with participants walking at 4 km h⁻¹ for 3 min at which point the speed increased at a rate of 1 km h⁻¹ min⁻¹ until volitional fatigue. Pulmonary gas exchange was measured breath by breath for the duration of the test with participants wearing a nose clip and breathing through a low-dead space (90 ml), low-resistance (0.75 mmHg · litres⁻¹ · s⁻¹ at 15 litres · s⁻¹) mouth-piece and impeller turbine assembly (Jaeger Triple V). The inspired and expired gas volume and gas concentration signals were sampled continuously at 100 Hz, the latter using paramagnetic (O₂) and infrared (CO₂) analysers (Jaeger Oxycon Pro, Hoechberg, Germany). These analysers were calibrated before each test with gases of known concentrations and the turbine volume transducer was calibrated using a 3-litre syringe (Hans Rudolph, Kansas City, MO). Oxygen uptake, carbon dioxide production (VCO₂), and ventilation (VE) were calculated using standard formulae (Beaver, Wasserman, & Whipp, 1973). The gas exchange threshold was determined using the Vslope method (Beaver, Wasserman, & Whipp, 1986), where the threshold is determined as the first disproportionate increase in VCO₂ relative to VO₂. The treadmill speed at the gas exchange threshold was then used during the exercise bout completed during visit 2.

Visit 2. Participants were briefed on the psychological measures using the protocol developed by Baden et al. (2004) and standard Telic State Measure definitions (Svebak & Murgatroyd, 1985). They then completed a 30-min treadmill run at the gas exchange threshold. Metamotivational state (telic or paratelic), RPE, and attentional focus were recorded at 5-min intervals. Pulmonary gas exchange was measured breath by breath as detailed above between minutes 1–3, 6–8, 11–13, 16–18, 21–23, and 26–28. Heart rate was recorded using short-range radio telemetry (Polar S610, Polar Electro Oy, Kempele, Finland) at minutes 3, 8, 13, 18, 23, and 28.

Visit 3. Six participants completed a third visit using the above protocol without pulmonary gas exchange measurement. Visits 2 and 3 were counterbalanced and the purpose of visit 3 was to determine if the collection of expired air resulted in a more associating focus.

Data analysis

To test for dominance effects, two-way analyses of variance (ANOVA: dominance × time), with repeated measures on time, were carried out on: RPE, attentional focus, metamotivational state, heart rate, and VO₂. Dominance had three levels (telic, paratelic, and non-dominance) and time had six levels (see above for different time points for different variables). Alpha was set at 0.05. Least significant difference post hoc tests and dependent t-tests, with Bonferroni correction, were planned to follow up any significant main effects or time main effects and dominance × time interactions, respectively.

To test for state effects, independent t-tests were carried out at each time point to compare RPE, attentional focus, heart rate, and VO₂ between the telic and paratelic states. Bonferroni correction was applied to each set of tests, resulting in an α of 0.0083.
Chi-squared analysis was used to examine the association between dominance and frequency of metamotivational states experienced during the exercise bout (α = 0.05).

For the six participants who completed two exercise trials, dependent t-tests were used to compare attentional focus between the two conditions: exercise with and without pulmonary gas exchange measurement. Bonferroni’s correction was applied, thus α was set at 0.0083.

Results
Dominance effects
There were no main effects of dominance or dominance × time interactions for any of the dependent variables (P > 0.05; descriptive statistics are reported in Table I, but for brevity non-significant results are not reported). Time main effects were observed for RPE (F(2.01,56.74) = 24.56, P < 0.05), metamotivational state (F(5,130) = 3.15, P < 0.05), heart rate (F(2.03,50.83) = 44.63, P < 0.05), and VO₂ (F(1.81,41.56) = 9.23, P < 0.05); the Greenhouse-Geisser statistic was used to correct for violation of the sphericity assumption except for metamotivational state. Dependent t-tests indicated that oxygen uptake was significantly lower (P < 0.05) between 1 and 3 min (31.87 ± 5.3 ml · kg⁻¹ · min⁻¹) than between 6 and 8 min (32.95 ± 5.4 ml · kg⁻¹ · min⁻¹) as would be expected at the onset of exercise. Rating of perceived exertion increased from minutes 5 (10.13 ± 2.7) to 10 (10.93 ± 2.0), 10 to 15 (11.8 ± 2.2), 15 to 20 (12.2 ± 2.4), and 20 to 25 (12.8 ± 2.6). Heart rate increased from minute 3 (154 ± 20 beats · min⁻¹) to 8 (160 ± 19 beats · min⁻¹), 18 (162 ± 20 beats · min⁻¹) to 23 (164 ± 19 beats · min⁻¹), and 23 to 28 (165 ± 19 beats · min⁻¹). When Bonferroni’s correction was applied to examine the time main effect for metamotivational state, no significant differences were revealed between consecutive time points (P > 0.05).

No dependent variables differed between the telic and paratelic states at 5, 10 or 15 min (P > 0.05) and VO₂ did not differ between states at any time point (P > 0.05; see Figure 1). Rating of perceived exertion was significantly higher in the telic than the paratelic state at 25 min (t₂₈ = 2.87, P < 0.05; telic state mean = 13.9 ± 2.5 and paratelic state mean = 11.5 ± 2.1) and 30 min (t₂₆.₇₆ = 3.88, P < 0.05; telic state mean = 14.2 ± 2.7 and paratelic state mean = 11.0 ± 1.7; see Table II and Figure 1). Attentional focus was significantly more associative in the telic than the paratelic state at 20 min (t₂₈ = −3.73, P < 0.05; telic state mean = −7.5 ± 44.4 and paratelic state mean = 43.8 ± 27.7), 25 min (t₂₈ = −4.85, P < 0.05; telic state mean = −25.8 ± 36.7 and paratelic state mean = 42.1 ± 40), and 30 min (t₂₇ = −5.14, P < 0.05; telic state mean = −27.0 ± 41 and paratelic state mean = 46.9 ± 33.4; see Table II and Figure 2). Heart rate was significantly higher in the telic than the paratelic state at 23 min only (t₂₇ = 3.40, 27.0 ± 23.5 min⁻¹).

Table I. Results for RPE, metamotivational state, attentional focus, heart rate (beats · min⁻¹), and VO₂ (ml · kg⁻¹ · min⁻¹) for the three dominance groups (mean ± σ)

<table>
<thead>
<tr>
<th>Variable</th>
<th>5 min</th>
<th>10 min</th>
<th>15 min</th>
<th>20 min</th>
<th>25 min</th>
<th>30 min</th>
</tr>
</thead>
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<td></td>
<td></td>
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<tr>
<td>Telic dominant</td>
<td>11.3 ± 3.9</td>
<td>11.1 ± 2.3</td>
<td>13.0 ± 0.8</td>
<td>13.8 ± 0.9</td>
<td>14.3 ± 0.9</td>
<td>14.0 ± 0.7</td>
</tr>
<tr>
<td>Paratelic dominant</td>
<td>9.6 ± 1.8</td>
<td>10.8 ± 2.0</td>
<td>12.7 ± 0.7</td>
<td>13.0 ± 0.6</td>
<td>14.2 ± 1.1</td>
<td>14.5 ± 1.4</td>
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<tr>
<td>Non-dominant</td>
<td>9.5 ± 1.7</td>
<td>10.9 ± 1.9</td>
<td>12.0 ± 0.6</td>
<td>12.3 ± 0.7</td>
<td>12.7 ± 0.9</td>
<td>13.0 ± 1.2</td>
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<tr>
<td>Metamotivational state</td>
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<tr>
<td>Telic dominant</td>
<td>3.3 ± 0.5</td>
<td>3.2 ± 0.3</td>
<td>2.5 ± 0.3</td>
<td>2.8 ± 0.3</td>
<td>2.8 ± 0.5</td>
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<td>3.7 ± 0.6</td>
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<td>3.8 ± 0.7</td>
<td>3.0 ± 0.7</td>
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<td>Non-dominant</td>
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<td>4.0 ± 1.0</td>
<td>3.7 ± 1.2</td>
<td>3.3 ± 1.3</td>
<td>3.3 ± 1.3</td>
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<tr>
<td>Attentional focus</td>
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<tr>
<td>Telic dominant</td>
<td>35.6 ± 31.0</td>
<td>17.8 ± 21.9</td>
<td>−3.3 ± 24.2</td>
<td>−5.0 ± 28.1</td>
<td>12.2 ± 31.6</td>
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<tr>
<td>Paratelic dominant</td>
<td>18.3 ± 21.3</td>
<td>13.0 ± 18.5</td>
<td>15.9 ± 16.6</td>
<td>37.0 ± 16.2</td>
<td>17.0 ± 20.4</td>
<td>1.9 ± 23.5</td>
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<td>Non-dominant</td>
<td>28.9 ± 37.0</td>
<td>25.2 ± 30.9</td>
<td>12.6 ± 45.9</td>
<td>14.8 ± 25.2</td>
<td>−14.1 ± 25.8</td>
<td>−5.2 ± 37.9</td>
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<tr>
<td>Heart rate</td>
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<tr>
<td>Telic dominant</td>
<td>3 min 156.5 ± 10.3</td>
<td>165.3 ± 10.6</td>
<td>170.3 ± 11.5</td>
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<td>Paratelic dominant</td>
<td>160.0 ± 5.1</td>
<td>169.3 ± 5.7</td>
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<td>Non-dominant</td>
<td>157.3 ± 4.1</td>
<td>163.3 ± 7.0</td>
<td>166.7 ± 7.7</td>
<td>170.0 ± 8.5</td>
<td>170.0 ± 8.0</td>
<td>172.0 ± 7.0</td>
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<tr>
<td>VO₂</td>
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<tr>
<td>Telic dominant</td>
<td>1–3 min 34.7 ± 1.7</td>
<td>36.6 ± 1.5</td>
<td>37.1 ± 1.3</td>
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<td>36.2 ± 1.7</td>
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<tr>
<td>Paratelic dominant</td>
<td>30.9 ± 1.8</td>
<td>33.1 ± 1.2</td>
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<td>33.0 ± 1.8</td>
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<tr>
<td>Non-dominant</td>
<td>37.9 ± 2.7</td>
<td>38.8 ± 2.1</td>
<td>39.5 ± 2.2</td>
<td>39.5 ± 2.2</td>
<td>39.8 ± 2.3</td>
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</tbody>
</table>
There was a significant association between dominance and state \[ \chi^2(2, N=60) = 11.57, \ P < 0.05 \]. This was largely attributable to a tendency for telic-dominant individuals to spend more time in the telic state (frequencies of experiencing telic and paratelic states of 41 and 18, respectively). Paratelic (telic state frequency = 25 and paratelic state frequency = 35) and non-dominant (telic state frequency = 26 and paratelic state frequency = 34) participants demonstrated less of a tendency to spend more time in the paratelic state.

Analysis of data from the subsample of six participants who completed the exercise trial twice indicated no significant difference between attentional focus at any of the six time points \( (P > 0.05) \). Thus shifts in attentional focus are unlikely to be an artefact of the insertion of breathing apparatus to measure VO\textsubscript{2}.

**Table II.** Results for RPE, attentional focus, heart rate (beats \cdot min\textsuperscript{-1}), and VO\textsubscript{2} (ml \cdot kg\textsuperscript{-1} \cdot min\textsuperscript{-1}) for the telic and paratelic states across all time points (mean ± s)

<table>
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<th>Variable</th>
<th>State</th>
<th>5 min (12, 18)</th>
<th>10 min (14, 16)</th>
<th>15 min (17, 13)</th>
<th>20 min (16, 14)</th>
<th>25 min (16, 14)</th>
<th>30 min (17, 12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>RPE</td>
<td>telic</td>
<td>11.1 ± 3.6</td>
<td>11.7 ± 2.0</td>
<td>12.3 ± 2.1</td>
<td>13.1 ± 2.3</td>
<td>13.9 ± 2.5</td>
<td>14.2 ± 2.7</td>
</tr>
<tr>
<td></td>
<td>paratelic</td>
<td>9.5 ± 1.7</td>
<td>10.3 ± 1.8</td>
<td>11.2 ± 2.3</td>
<td>11.07 ± 2.0</td>
<td>11.5 ± 2.1</td>
<td>11.0 ± 1.7</td>
</tr>
<tr>
<td>Attentional focus</td>
<td>telic</td>
<td>10.7 ± 49.5</td>
<td>1.9 ± 40.9</td>
<td>-2.8 ± 47.3</td>
<td>-7.5 ± 44.4</td>
<td>-25.8 ± 36.7</td>
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<tr>
<td></td>
<td>paratelic</td>
<td>33.4 ± 49.5</td>
<td>35.8 ± 42.0</td>
<td>39.7 ± 34.3</td>
<td>43.8 ± 27.7</td>
<td>42.1 ± 40.0</td>
<td>46.9 ± 33.4</td>
</tr>
<tr>
<td>Heart rate</td>
<td>3 min</td>
<td>149.6 ± 23.8</td>
<td>159.4 ± 19.4</td>
<td>162.2 ± 20.2</td>
<td>164.2 ± 20.7</td>
<td>172.8 ± 17.1</td>
<td>171.1 ± 19.3</td>
</tr>
<tr>
<td></td>
<td>8 min</td>
<td>155.2 ± 16.7</td>
<td>159.0 ± 19.1</td>
<td>162.0 ± 19.7</td>
<td>158.4 ± 17.4</td>
<td>152.9 ± 13.8</td>
<td>155.9 ± 14.1</td>
</tr>
<tr>
<td></td>
<td>13 min</td>
<td>35.2 ± 6.3</td>
<td>33.6 ± 6.5</td>
<td>33.7 ± 6.0</td>
<td>33.5 ± 6.2</td>
<td>34.3 ± 4.4</td>
<td>34.3 ± 4.3</td>
</tr>
<tr>
<td></td>
<td>18 min</td>
<td>31.5 ± 4.7</td>
<td>32.4 ± 4.4</td>
<td>32.1 ± 5.3</td>
<td>32.6 ± 5.3</td>
<td>31.7 ± 7.0</td>
<td>33.6 ± 6.2</td>
</tr>
</tbody>
</table>

**Discussion**

In this study, we examined two main research questions: (1) Do RPE and attentional focus differ during aerobic exercise in relation to metamotivational dominance? (2) Do RPE and attentional focus differ during aerobic exercise in relation to metamotivational state? Findings indicated that attentional focus and RPE differ in relation to the telic and paratelic metamotivational states, but not telic and paratelic metamotivational dominance. Thus, hypothesis 1 was not supported.

Compared with the paratelic state, attentional focus was more associative (at 20, 25, and 30 min) and RPE was higher (at 25 and 30 min) in the telic state. These differences cannot be attributed to differences in work rate between the two states, as VO\textsubscript{2} did not differ between states and therefore supports the dissociation between RPE and work rate noted by Garcin and colleagues (Garcin, Danel, ...
that the higher heart rate at 23 min in the telic state is not working harder in the telic state. Furthermore, by 28 min there was no difference in heart rate between the two groups.

The higher RPE and more associative attentional focus observed in the telic state at the later stages of the exercise bout support the study’s second hypothesis. In the telic state, as proposed by reversal theory, the individual is in a serious frame of mind, is goal oriented, and is focused on achieving something meaningful. Thus attention is focused on the activity itself and one’s physical and mental engagement with the activity (as also proposed by reversal theory). Similarly, while focusing on fulfilling the demands of the activity, the individual may be more aware of its demands, leading to higher RPE.

Practically, this implies that exercising in the telic state may result in a perception of greater effort. A widespread recommendation (e.g., Kyllo & Landers, 1995) is that exercisers should set specific goals for exercise sessions that will lead towards the achievement of longer-term goals. If this induces a telic state in the individual, at the later stages of exercise this may result in inflated perceptions of effort and task difficulty, as the exerciser may be most focused on their goal for that session, recognizing the effort involved in achieving this goal and assessing whether achievement of the goal is likely. Thus the exercise becomes a means to an end (a key characteristic of behaviour in the telic state), increasing the individual’s awareness of and perceived work rate. In contrast, in the paratelic state, the exerciser experiences the activity as an end in itself (a key characteristic of behaviour in this state) as a result of their non-goal-directed behaviour. Therefore, they are less aware of their work rate, resulting in lower RPE. Ironically, therefore, it may be worthwhile for exercisers to switch to a non-goal-oriented, paratelic state towards the end of an aerobic exercise bout to increase positive affect and perceived enjoyment, and possibly adherence to exercise (Williams et al., 2008). Future studies need to examine this speculative idea, as affect, enjoyment, and long-term exercise behaviour were not measured here.

In relation to our subsidiary question concerning time spent in the telic and paratelic states in relation to metamotivational dominance, an interesting observation is that while participants demonstrated a tendency to spend more time in their preferred state, this tendency was most marked in telic-dominant individuals and did not preclude individuals from experiencing their non-preferred state. Thus partial support was offered for hypothesis 3. Telic-dominant individuals’ greater preference to remain in the telic state has been noted previously; Frey (1999) suggested that telic-dominant individuals reverse easily into their dominant state but do not quickly satiate or become frustrated in this state. That current participants spent some time in the paratelic state.

& Billat, 2008). The more prominent role for state identified here supports a central argument in reversal theory, that metamotivational state, representing current phenomenological interpretation of experience, is key to understanding motivation and emotion, and not more stable dispositional characteristics, such as metamotivational dominance (Apter, 2001). Future research may benefit therefore from considering dynamic, situational motives during exercise, particularly of a prolonged duration.

The increase in RPE with increasing exercise duration during constant-pace exercise observed in other studies (e.g., Baden et al., 2005; Green et al., 2005) was replicated here. Previous studies showed a more associative attentional focus with increasing duration of exercise (e.g., Baden et al., 2004), but this was only evident in the current participants when they were in the telic state. As duration of exercise increased when participants were in the paratelic state, attentional focus was more, not less, dissociative. Although further research is needed to replicate this finding, a preliminary suggestion is that not all exercisers will shift to a more associative attentional focus as exercise continues. Instead, whether this shift occurs may depend on their dynamically changing metamotivational state.

At the later stages of the exercise bout, although work rate and intensity were constant, participants felt that they were working harder in the telic compared with the paratelic state. Previous research has demonstrated that, at higher exercise intensities, physiological parameters exert a greater influence on RPE than personal and situational factors (Boutcher & Trenske, 1990). In contrast, current results suggest that at constant intensity, with increases in exercise duration, the person variable – metamotivational state – becomes less but increasingly influential. As discussed previously, preferred exercise intensity can moderate the relationship between biologically based indicators of exertion and RPE (e.g., Dishman et al., 1994). Interpreted from a reversal theory perspective, this suggests that when the individual is in a telic state and prefers low levels of arousal (low exercise intensities), RPE is higher. In contrast, in the paratelic state, where high arousal (high exercise intensities) is preferred, RPE is lower. This appeared to be the case in the later stages of the current exercise protocol, suggesting that metamotivational state may be one of the factors that influence the uncoupling of RPE from biologically based indicators of exertion when the individual is exercising at a non-preferred exercise intensity. It is likely that the higher heart rate at 23 min in the telic state is erroneous, as the VO₂ values did not differ at the same time point, indicating that participants were not working harder in the telic state. Furthermore, the uncoupling of RPE from biologically based indicators of exertion and RPE is lower. It is likely that the higher heart rate at 23 min in the telic state may be one of the factors that influence the uncoupling of RPE from biologically based indicators of exertion when the individual is exercising at a non-preferred exercise intensity. It is likely that the higher heart rate at 23 min in the telic state is erroneous, as the VO₂ values did not differ at the same time point, indicating that participants were not working harder in the telic state. Furthermore,
may appear surprising given that a laboratory-based exercise protocol undertaken as part of a research study could be considered a somewhat telic activity that would consistently induce a telic state in participants. This lends support for Apter’s (2001) suggestion that reversals occur both frequently and involuntarily. Future researchers should conduct a more thorough examination of spontaneous state reversals during exercise and associated changes in perceptual and cognitive parameters. It may also help to know what factors induce reversals in state during endurance-based exercise testing protocols and any changes in perceptual and cognitive parameters that may be associated with these reversals.

Conclusion

In conclusion, some novel results have been revealed by this study. First, state, not dominance, appears to have a stronger influence on perceptual and cognitive responses during exercise, lending further support for reversal theory proposals. Second, during the later stages of aerobic exercise, the telic state is associated with a more associative attentional focus and higher RPE, suggesting that some benefit may be derived from reversing to the paratelic state during the later stages of exercise. Third, particularly in telic-dominant individuals, preference for congruence between state and dominance was demonstrated, again bolstering support for reversal theory proposals. Although current results suggest that metamotivational state, and not dominance, is related to perceptual and cognitive responses during exercise, an experimental design would help to more thoroughly examine this relationship. Manipulating metamotivational state will ensure that telic- and paratelic-dominant individuals exercise in both the telic and paratelic states, unlike in the present study where participants’ metamotivational states were determined by natural fluctuations in their motivational and perceptual experience.

References


