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# Stress responses during aerobic exercise in relation to motivational dominance and state

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# Stress responses during aerobic exercise in relation to motivational dominance and state

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**Abstract**

We examined the hypothesis that congruence between motivational dominance and state results in optimal psychological responses and performance during exercise. Twenty participants (10 telic dominant and 10 paratelic dominant) rated their stress at 5 min intervals as they cycled on an ergometer at gas exchange threshold for 30 min in both telic and paratelic state manipulated conditions. Participants then performed a test to exhaustion at a resistance equivalent to 110% of $\dot{V}O_{2max}$. The hypothesized interaction between condition and dominance was significant for internal tension stress, as paratelic dominants were more stressed than telic dominants when exercising in the telic state and telic dominants were more stressed than paratelic dominants when exercising in the paratelic state. Similarly, the condition × dominance interaction for internal stress discrepancy was significant, as paratelic dominants reported greater internal stress discrepancy exercising in the telic compared with the paratelic state. Findings are discussed in relation to the application of reversal theory for understanding stress responses during aerobic exercise.

**Keywords:** *Motivational dominance, motivational state, stress*

## Introduction

Although widely investigated and well documented in recent scientific texts (e.g. Biddle, Fox, & Boutcher, 2000; Lox, Martin-Ginis, & Petruzzello, 2006; Tenenbaum & Eklund, 2007), the psychological effects of exercise are less well understood than its physical benefits. In particular, our understanding of the processes underpinning psychological responses to acute exercise remains limited. Since recent studies have shown great inter-individual variability in psychological responses to exercise (e.g. Parfitt, Rose, & Burgess, 2006; Rose & Parfitt, 2007), identifying such processes is an important additional step in helping to understand why individuals do not react uniformly to the same exercise stimulus. State factors (e.g. self-efficacy; McAuley, Talbot, & Martinez, 1999; Robbins, Pis, Pender, & Kazanis, 2004) may influence these patterns of inter-individual variation in psychological responses to exercise, as may personality factors (e.g. approach and avoidance action tendencies; Schneider & Graham, 2009). However, there is a paucity of studies that have investigated the effects of personality on psychological responses to exercise.

Rose and Parfitt (2007) observed considerable inter-individual differences in sedentary women's affective responses to exercise of varying intensity. Participants reported that their affective responses to exercise were influenced by a number of person variables such as interpretation of intensity and expectations. Rose and Parfitt suggested that, "why someone feels the way he or she does during exercise . . . could be just as important as knowing how he or she feels" (p. 306).

In the current study, we employ reversal theory (Apter, 2001) which is used to predict and understand psychology and behaviour at dispositional and state levels, thus offering a suitable framework for investigating psychological responses to exercise. Reversal theory proposes that interpretation of an experience (e.g. exercise) is partially dependent on current motivational state, hence the same behaviour or event may be experienced or interpreted differently depending on the individual's motivational state.

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Motivational states define our motivation, what is currently important to us and how we interpret our experience. In this study, we examine the exercise experience in relation to the telic and paratelic states (there are eight states, paired as bipolar opposites; see Apter, 2001). In the telic state, we prefer low levels of arousal and are motivated to plan ahead and pursue serious meaningful activities with long-term consequences (e.g. an exerciser attempting to achieve a personal best on the treadmill in a gym training session). In the paratelic state, we prefer high levels of arousal and are motivated to act spontaneously and pursue activities with no long-term or meaningful consequences (e.g. an exerciser running in the woods for fun and enjoyment of the sensation of running). Different emotions are experienced as pleasant and unpleasant in the telic and paratelic states. In the telic state, relaxation is interpreted as pleasant and anxiety is interpreted as unpleasant, whereas in the paratelic state, excitement is interpreted as pleasant and boredom as unpleasant. We reverse between the states within each pair, but may have a tendency to prefer one state over the other, termed "motivational dominance", and this may influence how we interpret an event such as exercise or sport (e.g. Svebak & Kerr, 1989). Thus, individuals demonstrate an internal bias for, and prefer to spend time in, the state that matches their dominance (Apter, 2005).

Svebak (1990) has identified that when the individual's dominance and the nature of the sport do not match, the individual may experience unpleasant emotions. For instance, when a telic dominant individual participates in an arousal-inducing (or paratelic-oriented sport), they interpret the high level of experienced arousal as anxiety and not excitement as would a paratelic dominant individual. During telic-oriented sports (e.g. endurance running), the telic state is most likely experienced, while during paratelic-oriented sports (e.g. snowboarding), the paratelic state is most likely. Thus, telic dominant individuals prefer telic-oriented sports and paratelic dominant individuals prefer paratelic-oriented sports (e.g. Cogan & Brown, 1999; Kerr, 1991; Kerr & Svebak, 1989).

Spicer and Lyons (1997) examined the effects of a mismatch between dominance and state. They revealed that telic dominant women who experienced anxiety while engaged in conversation about themselves in the paratelic state demonstrated significant increases in diastolic blood pressure. The authors term this interactive effect of dominance and state a "misfit effect". Although Spicer and Lyons measured composure (relaxation) and anxiety, these were considered as independent and not dependent variables, therefore no evidence was revealed concerning the influence of this misfit effect on psychological responses during task performance.

A key psychological response to exercise is stress. Reversal theory proposes that individuals experience tension and effort stress, deriving from internal and external sources. Tension stress represents felt stress and results when the needs of the individual's current state are not met. Effort stress represents the stress incurred from efforts to cope with tension stress, but may be experienced in attempts to avoid this stress and therefore in its absence. Internal tension stress may result, for example, from the pressure an exerciser in the telic state has placed on him or herself to achieve an exercise goal and goal achievement appears unlikely. External tension stress may result, for example, when an individual in the telic state perceives pressure from an exercise partner to maintain the current work rate during an exercise session and this is proving difficult to achieve. Internal and external effort stress represents the individual's efforts to cope with this internal or external tension stress. It is proposed that tension stress is experienced as unpleasant in both the telic and paratelic states, whereas effort stress is only experienced as unpleasant in the telic state. In the paratelic state, effort stress is experienced as pleasant and invigorating because the individual is exerting effort towards an activity performed for its own sake (Apter, 2001).

Martin and colleagues (Martin, Kuiper, Olinger, & Dobbin, 1987) identified a link between motivational dominance and everyday stress. In their study, telic dominant individuals preferred to experience low levels of stress, whereas paratelic dominant individuals preferred to experience a degree of unresolved stress, interpreting this as an enjoyable challenge. There appears to be a lack of research into the relationship between stress and motivational dominance within an exercise context. However, a small number of researchers have used reversal theory to examine stress responses to exercise. In these studies, stress was measured before and after but not during exercise. Moreover, they did not account for motivational state, a serious omission in general in reversal theory research (Apter, 2001).

Kerr and Kuk (2001) observed increases in internal and external tension and effort stress from before to after running, a result replicated for internal tension and effort stress by Kerr and colleagues (Kerr, Wilson, Svebak, & Kirkcaldy, 2006b). All types of stress were higher before and after high-intensity compared with low-intensity running (Kerr & Kuk, 2001), and have been shown to be higher in outdoor compared with laboratory running for competitive but not recreational runners (Kerr et al., 2006a).

Males and Kerr (1996) proposed that if a discrepancy exists between tension and effort stress, decreases in sports performance might occur. This discrepancy (i.e. tension – effort stress) can occur if tension stress exceeds or is less than effort stress, suggesting that the individual is exerting either too much or too little effort stress to cope with experienced tension stress. This discrepancy can occur between both internal tension and effort stress and external tension and effort stress. Some authors have considered the link between stress discrepancy and sports performance, but support for this proposal is limited and equivocal (see Hudson, 1998; Males & Kerr, 1996). In addition, these studies have only considered stress discrepancy as an independent variable and not as an outcome variable.

Given the potential interplay between motivational dominance and state and the largely unexamined misfit effect (Spicer & Lyons, 1997), more research is needed that considers both motivational state and dominance. Only two sport or exercise based studies have examined the interactive effects of dominance and state. In the first of these, elite telic dominant athletes performed a strength task in a paratelic, telic, and a neutral state, combined with either high or low arousal (Perkins, Wilson, & Kerr, 2001). Performance was superior when athletes experienced the paratelic state, thus lending no support for the misfit effect. However, with only one dominance group the study did not offer a full examination of this effect, and did not consider the individual's psychological response to the activity. The second was a descriptive study that compared ratings of perceived exertion (RPE: Borg, 1973) and attentional focus in telic, paratelic, and non-dominant individuals, revealing no differences in relation to dominance during treadmill running (Thatcher, Kuroda, Thatcher, & Legrand, 2010). Differences in RPE and attentional focus were found in relation to motivational state at different stages of the exercise, but these authors did not examine potential interactive effects between dominance and state. To do so requires an experimental approach involving motivational state manipulation in telic and paratelic dominants. Thus, the aim of the current study was to manipulate motivational state to examine stress responses and performance during exercise in relation to motivational dominance and state.

In doing so, we attempt to make a number of contributions to this area. First, we consider why individuals experience different psychological responses during exercise (Rose & Parfitt, 2007). Second, systematic research using reversal theory in this context is lacking (Ekkekakis & Petruzzello, 1999) and although this body of research is growing, there is a need for further work. Consequently, we extend understanding of the applicability of reversal theory to examining psychological responses to exercise. Third, the study is the first to offer a full examination of the misfit effect (Spicer & Lyons, 1997) within an exercise context. Based on theoretical proposals and research findings (Apter, 2005; Spicer & Lyons, 1997), we first hypothesized that during exercise telic dominants would experience more internal and external tension and effort stress in the paratelic state and paratelic dominants would experience more internal and external tension and effort stress in the telic state. Second, we hypothesized that telic dominants would report greater internal and external stress discrepancy when exercising in the paratelic state, and vice versa for paratelic dominants. Our third hypothesis was that telic dominants would perform better on an exercise test in the telic state and paratelic dominants in the paratelic state.

## Methods

### Participants

Participants were 20 healthy volunteers purposely sampled from 157 respondents to the Paratelic Dominance Scale (PDS; Cook & Gerkovich, 1993; see below). Telic dominance was identified as a PDS score greater than one standard deviation below the mean ($16.05 \pm 5.71$) and paratelic dominance as a PDS score greater than one standard deviation above the mean (Thatcher et al., 2010). Ten participants were telic dominant (mean PDS score $= 6.2 \pm 2.9$; 6 females and 4 males) and ten were paratelic dominant (mean PDS score $= 23.8 \pm 1.4$; 4 females and 6 males). Participants were aged 18.4–28.6 years (mean $= 19.6 \pm 2.6$ years) and participated an average of 3.5 times per week in a range of sport/exercise activities. Ethical approval was received from the University Ethics Committee and participants provided informed consent to take part in the study.

### Measures

*Motivational dominance* was assessed using overall PDS score. A forced choice response format (*True/False*) is used with true responses scored 1 (paratelic option) and false responses scored 0 (telic option). The convergent, discriminant, and construct validity of the PDS are good, as is its internal consistency ($\alpha = 0.87$ and 0.86 for odd and even numbered items, respectively; Apter & Deselles, 2001; Cook & Gerkovich, 1993).

*Motivational state (telic-paratelic)* was assessed using item 1 from the Telic State Measure (TSM: Svebak & Murgatroyd, 1985) as in previous research (e.g. Thatcher et al., 2010). Respondents use a

6-point Likert scale to indicate the degree to which they feel *serious* (1) or *playful* (6).

*Stress* was measured using the four stress items from the Tension Effort Stress Inventory (TESI: Svebak, 1993). Responses are recorded using 7-point Likert scales anchored by 1 (*No pressure*) and 7 (*Very much*) for internal and external tension stress and 1 (*No effort*) and 7 (*Very much*) for internal and external effort stress. Stress discrepancy scores were calculated for internal and external stress by subtracting effort from tension ratings. The TESI has been widely used in sport and exercise research (e.g. Kerr & Kuk, 2001), but its use of single items precludes the calculation of consistency and stability indices.

*Performance* was measured using a test to exhaustion on a cycle ergometer with resistance equivalent to 110% of the resistance at the participant's maximum oxygen uptake ($\dot{V}O_{2max}$). Participants were required to remain seated throughout and performance was recorded in seconds.

### *Procedure*

Participants were recruited verbally or via email. They attended the laboratory on three occasions at least 24 h apart. The first visit included a preliminary exercise test, while the second and third visits included the exercise trial where motivational state was manipulated. The latter two visits were counterbalanced between participants within dominance groups.

*Visit 1.* Participants completed a PAR-Q and a ramped cycle ergometer test to determine cycling resistance at the gas exchange threshold. Pulmonary gas exchange was measured breath by breath throughout. Participants wore a nose clip and breathed through a low-dead space (90 ml), low-resistance (0.75 mmHg $\cdot$ $l^{-1}$ $\cdot$ $s^{-1}$ at 15 litres $\cdot$ $s^{-1}$) mouthpiece and impeller turbine assembly (Jaeger Triple V). Inspired and expired gas volume and concentration signals were sampled continuously at 100 Hz, using paramagnetic ($O_2$) and infrared ($CO_2$) analysers (Jaeger Oxycon Pro, Hoechberg, Germany) to sample the latter. 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). Standard formulae (Beaver, Wasserman, & Whipp, 1973) were used to calculate oxygen uptake ($\dot{V}O_2$), carbon dioxide production ($\dot{V}CO_2$), and ventilation ($\dot{V}_E$). The gas exchange threshold was determined using the V-slope method (Beaver, Wasserman, & Whipp, 1986) and is identified as the first disproportionate increase in $\dot{V}CO_2$ relative to $\dot{V}O_2$. During visits 2 and 3, participants cycled at the resistance equal to their gas exchange threshold.

*Visits 2 and 3.* To ensure that participants were in the correct motivational states for the exercise bout, motivational states were manipulated using video stimuli, which have been used previously to manipulate psychological state (e.g. Sakuragi, Sugiyama, & Takeuchi, 2002). Participants watched 10 min of a comedy (paratelic condition) or a documentary video (telic condition) and completed item 1 from the TSM before and after exercise. Participants cycled for 30 min at a resistance equivalent to their gas exchange threshold. Motivational state and stress were recorded at 5 min intervals. Pulmonary gas exchange was measured between minutes 1–3, 6–8, 11–13, 16–18, 21–23, and 26–28. Participants watched the appropriate video throughout exercise and completed the performance test immediately after the exercise bout.

### *Data analysis*

Three-way mixed analyses of variance (ANOVAs) with repeated measures on time and condition (dominance × condition × time) were applied to motivational state, stress measures, and oxygen uptake (to check for work rate comparability between conditions and dominance groups). Dominance and condition had two levels (telic and paratelic) and time had six levels (see above). Significant interactions were explored using independent or dependent *t*-tests as appropriate, applying Bonferroni's correction factor to account for multiple analyses (adjusted alphas are reported). A two-way mixed ANOVA (dominance × condition) with repeated measures on condition was carried out on performance. Planned follow-up analyses were as above. Interaction effects were used to test the hypotheses, thus main effects are not reported. Dependent *t*-tests, with Bonferroni's correction factor, were used to compare motivational states before and after manipulation.

## Results

### *Manipulation check*

In the telic state, participants became significantly more telic after the manipulation ($t_{19} = 2.94$, $P < 0.017$, partial $\eta^2 = 0.31$; before $= 3.60 \pm 1.23$; after $= 2.95 \pm 1.57$), whereas in the paratelic state, participants became significantly more paratelic after the manipulation ($t_{19} = -3.91$, $P < 0.017$, partial $\eta^2 = 0.45$; before $= 3.95 \pm 1.64$; after $= 4.65 \pm 1.42$). Throughout exercise, participants were significantly more telic in the telic state condition (mean over time $= 2.54 \pm 1.08$) and paratelic in the paratelic state condition (mean over time = 3.89 ± 1.58) ($t_{19}$ = –8.84, $P < 0.017$, partial $\eta^2 = 0.40$).

Work rate did not differ between conditions or dominance groups as the ANOVA on oxygen uptake revealed no significant main effects or interactions ($P > 0.05$; for brevity these data are not reported).

Table I reports the descriptive statistics for all dependent variables.

### *Stress*

Hypothesis 1, that telic dominants would experience more internal and external tension and effort stress in the paratelic state, and paratelic dominants in the telic state, was partially supported. No significant interactions were revealed for external tension and effort stress or internal effort stress ($F_{1,18} = 1.01$, $P > 0.05$, partial $\eta^2 = 0.05$; $F_{1,18} = 0.70$, $P > 0.05$, partial $\eta^2 = 0.04$; and $F_{1,18} = 1.75$, $P > 0.05$, partial $\eta^2 = 0.09$, respectively). The hypothesized interaction between condition and dominance was significant for internal tension stress ($F_{1,18} = 6.55$, $P < 0.05$, partial $\eta^2 = 0.27$). Paratelic dominants were more stressed than telic dominants when exercising in the telic state ($t_{59} = -7.83$, $P < 0.0125$, partial $\eta^2 = 0.51$). Telic dominants were more stressed than paratelic dominants when exercising in the paratelic state ($t_{59} = -2.85$, $P < 0.0125$, partial $\eta^2 = 0.12$) (see Table I and Figure 1).

### *Stress discrepancy*

Hypothesis 2, that telic dominants would report greater internal and external stress discrepancy when exercising in the paratelic state, and paratelic dominants in the telic state, was partially supported, as no significant interaction between condition and dominance was revealed for external stress discrepancy ($F_{1,18} = 0.37$, $P > 0.05$, partial $\eta^2 = 0.02$). However, the condition × dominance interaction for internal stress discrepancy was significant ($F_{1,18} = 4.81$, $P < 0.05$, partial $\eta^2 = 0.21$). Paratelic dominants reported greater internal stress discrepancy exercising in the telic compared with the paratelic state ($t_{59} = 2.43$, $P < 0.025$, $t_{59} = 2.43$, $P < 0.025$, partial $\eta^2 = 0.09$; telic state mean = 0.50 ± 0.60; paratelic state mean = 0.28 ± 0.49). This discrepancy was positive (tension > effort stress) in both the telic and paratelic states. In telic dominants, internal stress discrepancy was greater when they exercised in the paratelic compared with the telic state but this effect was not significant ($t_{59} = -1.81$, $P = 0.075$, partial $\eta^2 = 0.05$; telic state mean = –0.07 ± 0.86, paratelic state mean = 0.17 ± 0.83) (see Table I and Figure 2).

Table I. Means and standard deviations in relation to condition and dominance.

| | Telic state condition | Paratelic state condition |
|---|---|---|
| **Telic dominants** | | |
| Internal Tension Stress* | 3.42 ± 1.49 | 3.40 ± 1.53 |
| Internal Effort Stress | 3.48 ± 1.60 | 3.23 ± 1.63 |
| External Tension Stress | 3.07 ± 1.47 | 2.27 ± 1.19 |
| External Effort Stress | 2.98 ± 1.59 | 2.32 ± 1.51 |
| Internal Stress Discrepancy | –0.07 ± 0.86 | 0.17 ± 1.83 |
| External Stress Discrepancy | 0.08 ± 0.83 | –0.05 ± 0.75 |
| Performance (s) | 63.41 ± 22.78 | 69.65 ± 21.60 |
| **Paratelic dominants** | | |
| Internal Tension Stress* | 3.78 ± 1.25 | 2.82 ± 0.98 |
| Internal Effort Stress | 3.28 ± 1.34 | 2.53 ± 1.02 |
| External Tension Stress | 3.13 ± 1.27 | 1.92 ± 0.93 |
| External Effort Stress | 2.75 ± 1.19 | 1.68 ± 0.83 |
| Internal Stress Discrepancy* | 0.50 ± 0.60 | 0.28 ± 0.49 |
| External Stress Discrepancy | 0.48 ± 0.60 | 0.23 ± 0.43 |
| Performance (s) | 79.08 ± 42.14 | 70.50 ± 19.94 |

*Significant interaction effect.

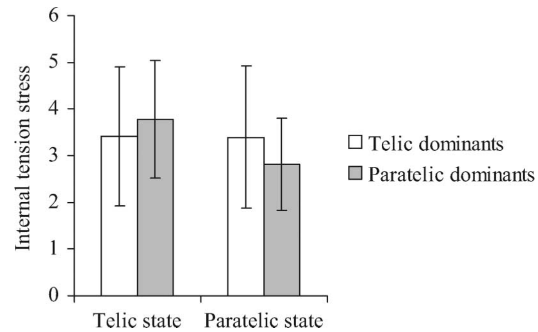


Figure 1. Internal tension stress in relation to state and dominance.

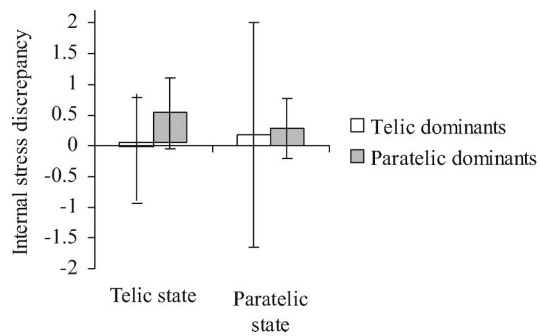


Figure 2. Internal stress discrepancy in relation to state and dominance.

### *Performance*

The third hypothesis, that telic dominant individuals would perform better in the telic state and paratelic dominants in the paratelic state was not supported, as no condition × dominance interaction for performance was observed ($F_{1,18} = 1.07$, $P > 0.05$, partial $\eta^2 = 0.06$).

## Discussion

We examined stress and performance in relation to motivational dominance and state during laboratory-based aerobic exercise. Performance did not differ in relation to motivational state or dominance, nor did tension and effort stress or external stress discrepancy. As predicted, internal tension stress and internal stress discrepancy differed in relation to dominance and state. In the paratelic state, telic dominants were more stressed than paratelic dominants, and vice versa in the telic state. Also, paratelic dominants reported greater stress discrepancy in the telic than in the paratelic state. Support was therefore mixed for the misfit effect (Spicer & Lyons, 1997). Current results support this effect in relation to internal tension stress and stress discrepancy, but not performance or external stress.

The lower stress and stress discrepancy observed when participants' state and dominance were matched might suggest that exercisers should be encouraged to exercise in a state that matches their dominance. It is often recommended (e.g. Kyllo & Landers, 1995) that exercisers should set specific goals for an exercise session, which may induce a telic state (e.g. rowing a target number of metres in a specified time on a rowing ergometer). However, paratelic dominant individuals may experience increased stress in this state, which may not be effectively matched by coping effort. Thatcher et al. (2010) found that regardless of dominance, participants reported higher ratings of perceived exertion towards the end of an aerobic exercise bout leading to a similar suggestion that exercisers may not always benefit from setting goals for exercise. Thatcher et al. (2010) did not find differences between dominances, but the current results suggest that this may only be the case for paratelic dominants.

Kerr and Svebak (1994) identified that levels of tension and effort stress experienced during sport depend on the type of sport and the activity performed within that sport. Current results suggest, somewhat more in accordance with reversal theory's phenomenological emphasis, that level of internal tension stress during exercise depends on both dispositional and state factors (i.e. motivational dominance and state).

External stress did not differ in relation to dominance or state, which suggests that the effects seen for internal stress were not attributable to the state manipulation (a potential external stressor), but to the individual's internal state, including, among other factors, motivational state. The manipulation check confirmed that state was manipulated as intended. Thus, the internal tension stress felt by paratelic dominants in the telic state and telic dominants in the paratelic state can be attributed with some confidence to the incongruence between state and dominance. Other person factors will contribute to the individual's internal state, including the salience during exercise of the other motivational states identified within reversal theory. In future, researchers could examine additional contributors to the individual's internal state and examine their relative roles in predicting stress experienced during exercise.

Paratelic dominants reported a positive internal stress discrepancy during exercise in both states (i.e. coping effort was less than experienced stress), with a significantly larger discrepancy in the telic than in the paratelic state. Thus, paratelic but not telic dominant individuals exerted less effort than required to match experienced stress when exercising in a state that did not match their dominance. This finding suggests that, when paratelic dominant individuals experience stress induced by exercise in their non-preferred state, because motivational state and dominance are misaligned, they do not feel it is worthwhile attempting, or feel able, to cope with experienced stress.

Tension stress is always experienced as unpleasant in the telic state (Apter, 2001). Therefore, in the telic state it is likely that individuals would exert at least sufficient effort stress to compensate for this unpleasant tension stress. This was not the case for paratelic dominant individuals and the non-significant effect for telic dominant individuals does not offer insight into their response. However, for paratelic dominants, it may be that the interaction between motivational dominance and state, and not just state, determines how tension stress is experienced. This appears to be a plausible explanation, as paratelic dominants prefer to experience some unresolved stress in everyday life and will interpret this stress as a challenge (Martin et al., 1987). In contrast, this is not the case for telic dominant individuals.

A key strength of this study is the manipulation of state before and during exercise and thus the development of a method for use in future research. Monitoring of state throughout exercise did support the overall effectiveness of this manipulation; nevertheless, some participants did experience state reversals. In particular, during the performance test it is possible that regardless of the prior manipulation, participants were in or reversed to the telic state and any changes in motivational state could not be monitored during this test. This is one of the central and unique tenets of reversal theory, but ironically presents an inherent challenge for researchers to develop innovative measures that allow instantaneous assessment of states in dynamic situations such as exercise. This factor is a limitation of this study, as results only suggest with any certainty that performance does not differ in relation to dominance and state *following* exercise in the telic or paratelic state. In future, researchers could attempt to examine state *in situ* during a similar performance test.

A further strength of this study, and an omission previously (e.g. Kerr & Kuk, 2001; Kerr et al., 2006a, 2006b), is the objective measurement of work rate in each condition to confirm that any effects were not attributable to differences in work rate between dominances and conditions. The final strength of this study was the measurement of stress responses during exercise and not only before and after exercise, as was the case in previous work in this area. This measure was obtained via the use of laboratory-based exercise to allow examination of cause and effect. Clearly, this limits the ecological validity of these findings and in future researchers could address this limitation. Researchers who seek to address these limitations and develop this line of inquiry should also employ a larger sample size, as the sample in the present study limited the statistical power and may have contributed to observed non-significant effects.

Nevertheless, this study offers novel findings concerning the processes underpinning individual differences in psychological responses to acute exercise. At least in relation to stress, an interactional approach that considers both dispositional and state factors may best address Rose and Parfitt's (2007) question of *why* someone feels as he or she does during exercise. Reversal theory offers a worthwhile framework for this research. As the first reported attempt to manipulate state to examine stress throughout exercise, the study makes a unique contribution and an initial step towards examining the misfit effect in relation to metamotivational state and dominance in exercise. Although only partial support was offered for this effect, it is nevertheless premature to dismiss this proposal with only a limited evidence base. Future work is needed to examine additional motivational states and affective responses outlined in reversal theory.

## References


Apter, M. J. (2001). An introduction to reversal theory. In M. J. Apter (Ed.), *Motivational styles in everyday life: A guide to reversal theory* (pp. 3–36). Washington, DC: American Psychological Association.

Apter, M. J. (2005). *Personality dynamics: Key concepts in reversal theory*. Loughborough: Apter International Ltd.

Apter, M. J., & Deselles, M. (2001). Reversal theory measures. In M. J. Apter (Ed.), *Motivational styles in everyday life: A guide to reversal theory* (pp. 55–76). Washington, DC: American Psychological Association.

Beaver, W. L., Wasserman, K., & Whipp, B. J. (1973). On-line computer analysis and breath-by-breath graphical display of exercise function tests. *Journal of Applied Physiology*, *34*, 128–132.

Beaver, W. L., Wasserman, K., & Whipp, B. J. (1986). A new method for detecting anaerobic threshold by gas exchange. *Journal of Applied Physiology*, *60*, 2020–2027.

Biddle, S. J. H., Fox, K. R., & Boutcher, S. H. (2000). *Physical activity and psychological well-being*. London: Routledge.

Borg, G. (1973). Perceived exertion: A note on history and methods. *Medicine and Science in Sports and Exercise*, *5*, 90–93.

Cogan, N., & Brown, R. (1999). Metamotivational dominance, states and injuries in risk and safe sports. *Personality and Individual Differences*, *27*, 503–518.

Cook, M. R., & Gerkovich, M. M. (1993). The development of a paratelic dominance scale. In J. H. Kerr, S. Murgatroyd, & M. J. Apter (Eds.), *Advances in reversal theory* (pp. 178–188). Amsterdam: Swets & Zeitlinger.

Ekkekakis, P., & Petruzzello, S. J. (1999). Acute aerobic exercise and affect: Current status, problems, and prospects regarding dose–response. *Sports Medicine*, *28*, 337–374.

Hudson, J. (1998). Stress and arousal in elite youth badminton players: A Reversal Theory perspective. In A. Lees, I. Maynard, M. Hughes, & T. Reilly (Eds.), *Science and racket sports II.* (pp. 174–178). London: E & FN Spon.

Kerr, J. H. (1991). Arousal-seeking in risk sport participants. *Personality and Individual Differences*, *12*, 613–616.

Kerr, J. H., Fujiyama, H., Sugano, A., Okamura, T., Chang, M., & Onouha, F. (2006a). Psychological responses to exercising in laboratory and natural environments. *Psychology of Sport and Exercise*, *7*, 345–359.

Kerr, J. H., & Kuk, G. (2001). The effects of low and high intensity exercise on emotions, stress and effort. *Psychology of Sport and Exercise*, *2*, 173–186.

Kerr, J. H., & Svebak, S. (1989). Motivational aspects of preference for and participation in risk sports. *Personality and Individual Differences*, *10*, 797–800.

Kerr, J. H., & Svebak, S. (1994). The acute effects of participation in sport on mood: The importance of level of "antagonistic physical interaction". *Personality and Individual Differences*, *16*, 337–338.

Kerr, J. H., Wilson, G. V., Svebak, S., & Kirkcaldy, B. D. (2006b). Matches and mismatches between telic dominance and type of sport: Changes in emotions and stress pre- to post-performance. *Personality and Individual Differences*, *40*, 1557–1567.

Kyllo, L. B., & Landers, D. M. (1995). Goal setting in sport and exercise: A research synthesis to resolve the controversy. *Journal of Sport and Exercise Psychology*, *17*, 117–137.

Lox, C. L., Martin-Ginis, K. A., & Petruzzello, S. J. (2006). *The psychology of exercise: Integrating theory and practice* (2nd edn.). Scottsdale, AZ: Holcomb Hathaway Publishers.

Males, J. R., & Kerr, J. H. (1996). Stress, emotion and performance in elite slalom canoeists. *The Sport Psychologist*, *10*, 17–36.

Martin, R. A., Kuiper, N. A., Olinger, L. J., & Dobbin, J. (1987). Is stress always bad? Telic versus paratelic dominance as a stress-moderating variable. *Journal of Personality and Social Psychology*, *53*, 970–982.

McAuley, E., Talbot, H.-M., & Martinez, S. (1999). Manipulating self-efficacy in the exercise environment in women: Influences on affective responses. *Health Psychology*, *18*, 288–294.

Parfitt, G., Rose, E. A., & Burgess, W. M. (2006). The psychological and physiological responses of sedentary individuals to prescribed and preferred intensity exercise. *British Journal of Health Psychology*, *11*, 39–53.

Perkins, D., Wilson, G. V., & Kerr, J. H. (2001). The effects of elevated arousal and mood on maximal strength performance in athletes. *Journal of Applied Sport Psychology*, *13*, 239–259.

Robbins, L. B., Pis, M. B., Pender, N. J., & Kazanis, A. S. (2004). Exercise self-efficacy, enjoyment, and feeling states among adolescents. *Western Journal of Nursing Research*, *26*, 699–715.

Rose, E. A., & Parfitt, G. (2007). A quantitative analysis and qualitative explanation of the individual differences in affective responses to prescribed and self-selected exercise intensities. *Journal of Sport and Exercise Psychology*, *29*, 281–309.

Sakuragi, S., Sugiyama, Y., & Takeuchi, K. (2002). Effects of laughing and weeping on mood and heart rate variability. *Journal of Physiological Anthropology and Applied Human Science*, *21*, 159–165.

Schneider, M. L., & Graham, D. J. (2009). Personality, physical fitness, and affective response to exercise among adolescents. *Medicine and Science in Sports and Exercise*, *41*, 947–955.

Spicer, J., & Lyons, A. C. (1997). Cardiovascular reactivity and mode-dominance misfit. In S. Svebak & M. J. Apter (Eds.), *Stress and health: A reversal theory perspective* (pp. 81–92). Washington, DC: Taylor & Francis.

Svebak, S. (1990). Personality and sports participation. In G. P. H. Hermans & W. L. Mosterd (Eds.), *Sports, medicine and health* (pp. 87–96). Amsterdam: Elsevier.

Svebak, S. (1993). The development of the Tension and Effort Stress Inventory (TESI). In J. H. Kerr, S. Murgatroyd, & M. J. Apter (Eds.), *Advances in reversal theory* (pp. 189–204). Amsterdam: Swets & Zeitlinger.

Svebak, S., & Kerr, J. H. (1989). The role of impulsivity in preference for sports. In J. H. Kerr (Ed.), *Motivation and emotion in sport* (pp. 27–46). Hove, UK: Psychology Press.

Svebak, S., & Murgatroyd, S. (1985). Metamotivational dominance: A multimethod validation of reversal theory constructs. *Journal of Personality and Social Psychology*, *73*, 505–512.

Tenenbaum, G., & Eklund, R. C. (2007). *Handbook of sport psychology* (3rd edn.). Hoboken, NJ: Wiley.

Thatcher, J., Kuroda, Y., Thatcher, R., & Legrand, F. D. (2010). Perceptual and cognitive responses during exercise: Relationships with metamotivational state and dominance. *European Journal of Sport Science*, *10*, 199–207.