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Research

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Motivational State Does Not Affect All-Out Short Duration Exercise Performance

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ABSTRACT

Introduction: The preferred motivational state (telic or paratelic), i.e., dominance, has been linked to the type of activity sports people participate in. As such, positive or negative performance may occur if there is a mismatch between the activity and the required state. This study set out to examine the effects of altering telic or paratelic motivational states and thus induce the "misfit effect" in order to quantify the influences on emotions and performance during all-out, short duration cycle performance.

Methods: Based on paratelic dominance scale (PDS) scores participants completed the Wingate anaerobic test (WAT) on two separate occasions in their preferred and non-preferred motivational state. Special video display method was used to manipulate participants to their non-preferred motivational state and verified *via* the telic state measure (TSM) test prior to performing the Wingate test (WT). Changes in emotion and stress levels were recorded using the tension and effort stress inventory (TESI) along with heart rate variability (HRV) data obtained from electrocardiogram (ECG). Peak power (PP), mean power (MP) and fatigue index (FI) obtained from the WT were used to assess all-out athletic performance.

Results: The main findings show that there was no link between dominant motivational state and anaerobic cycle performance ($p>0.05$) and that successful manipulation of motivational state ($p<0.05$) did not influence perceived levels or physiological levels of stress ($p>0.05$) and did not affect all-out, short duration cycle performance ($p<0.05$).

Conclusion: As such, coaches, support staff and athletes do not have to worry about a particular state in regards to telic or paratelic in an acute time frame, as long as the athlete's arousal levels and emotional conditions are optimal.

KEY WORDS: Reversal theory; Performance; Telic-paratelic; Emotions; Manipulating motivational state.

ABBREVIATIONS: ECG: Electrocardiogram; RT: Reversal theory; TD: Telic Dominant; PD: Paratelic; TSM: Telic State Measure; TESI: Tension and Effort Stress Inventory; HRV: Heart Rate Variability; PDS: Paratelic Dominance Scale; WAT: Wingate Anaerobic Test; WT: Wingate Test; MP: Mean Power; FI: Fatigue Index; RMSSDs: Root Mean Square of Successive Heartbeat Interval Differences.

INTRODUCTION

Exercise can have a positive influence on both physical and psychological well-being,[1] which encompasses emotional and stress responses.[2,3] However, this is not the case for all individuals as emotion and stress responses differ among individuals depending on personality and/or exercise mode.[4]

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The reversal theory (RT)[5] has been used to examine individual differences in emotional and physiological responses to exercise[6,7] and proposes that our present motivational state will influence how we interpret our experiences. Eight motivational states exist within RT and have been organised into 4 pairs of bipolar opposites (telic-paratelic, negativist-conformist, mastery-sympathy, and autic-alloic states) that are mutually exclusive, but reversible. Each pair of states is characterised by a distinct underpinning motivational focus and for the telic-paratelic state pair this is 'means and ends'. In the telic (or serious) state the focus is on achieving goals (possibly imposed) and on the future consequences of current experience. Athletes dominant in this state prefer low arousal levels prior to competition.[8] Alternatively, the paratelic state dominant athletes focus on non-essential, freely chosen goals with emphasis on the value of current experiences for their own sake, while lacking regard for future consequences and preferring to be spontaneous.[5] Athletes dominant in this state prefer high arousal levels prior to competition.[9] Interestingly, when the telic dominant individuals are highly aroused, they experience high levels of anxiety as a negative, and similarly if paratelic dominant individuals are not aroused to a high enough level, they experience boredom.

Intertwined within reversal theory are two forms of stress generated internally or externally. These include "tension" which is brought about when preferred levels of arousal, emotions and needs are not met. Increases in this emotion are usually caused by experiencing contingent events (a sudden change in the tone or nature of a situation), frustration situation (when needs are not being met by the current circumstances), and/or satiation (spending a long time in a particular state).[5] The second form of stress is "effort" produced by attempts to reduce tension stress.

As previously intimated, individuals tend to have a preference for one of the paired motivational states and thus spend more time in that state. This is referred to as motivational dominance. Previously, it has been suggested that participating in a non-preferred motivational state (i.e., paratelic as opposed to telic) has negative connotations regarding emotions and ultimately sports performance.[10-12] This mismatched interaction between dominance, state and performance has been labelled the "misfit effect".[13] However, the "misfit effect" does not always occur[14] even though participants were more relaxed in their preferred motivational state.

As such, the aim of the current study is to examine the effects of altering telic or paratelic motivational states and thus induce the "misfit effect" in order to quantify the influence on emotions, stress and performance during all-out, short duration cycle performance. It is hypothesised that during all-out, short duration exercise performance will hampered, present greater levels of stress and negative emotions when performing in the non-preferred (non-dominant) motivational state.

METHODS

PARTICIPANTS

From the initial participant pool of 232 University students, eighteen participants (aged 21.0±5.3 years) were recruited based on their paratelic dominance scores.[15] Selection was based on those participants who scored one standard deviation above the mean (21.42) for paratelic dominance and one standard deviation below the mean (9.91) for telic dominance.[14-16] The telic dominant (TD) group comprised 5 males and 4 females aged 23.3±4.5 years, with a mean exercise frequency of 3.7±1.4 sessions per week. The paratelic dominant (PD) group comprised five males and four females aged 21.8±6.2 years with a mean exercise frequency of 3.9±2.2 sessions per week. All participants provided written informed consent in compliance with the Declaration of Helsinki.[17]

Procedures

Participants attended the laboratory on four separate occasions at the same time of day. The first two sessions were used for familiarization and the third and fourth sessions, administered the experimental trials in counterbalanced order within dominance groups. A cross-over design was employed for each of the two groups, TD and PD, independently.

On arrival at the laboratory the participants' skin was prepared by shaving and cleaning with an alcohol swab before the placement of Ag/AgCl electrodes for electrocardiogram (ECG) measurements. Three electrodes were placed in the left and right intra jugular fossa and one close to the apex of heart.[18] Electrocardiographic activity was recorded *via* bio-amp and PowerLab 4/25 (Model 845, ADInstruments, Castle Hill, Australia) with the ECG signal sampled at 1000 Hz. Participants were instructed to sit on a chair in front of a 1.3 m×1.5 m screen and whereupon they were asked to complete the Telic State Measure test (TSM) in order to determine motivational state (telic or paratelic),[16] with associated arousal and effort levels. The TSM consists of five items to determine motivational state and arousal levels (serious-playful, planning-spontaneous, felt arousal (low-high), preferred arousal (low-high) and effort given for the task (low-high). A rating consists of 6 points with low scores for the first two items indicating a telic state, and high scores indicating a paratelic state. The four items were selected to be used based on previous research investigating similar manipulations of motivational state.[6,11]

Subsequently, the tension and effort stress inventory (TESI)[19] was completed in order to determine tension and effort stress along with measures of emotion (relaxation, anxiety, excitement, and boredom[14]) prior to performance. TESI consists of 20 items to measure stress (tension and effort) and pleasant or unpleasant emotions. of the inventory uses a seven points scale ('not at all' equaling 1 and 'very much' equalling 7) for each

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item. For this study we examined stress and four somatic emotions (anxiety, excitement, boredom and relaxation), which is emotion associated with exercise.[20]

ECG was measured for 5 min whilst the video manipulation was administered.[14]

Participants then completed a 5 min warm up during which they completed a second TSM and TESI, used as a state manipulation check (pre-performance) followed by the 30 s all-out Wingate cycle sprint test[21] using a Lode Excalibur Sport cycle ergometer (Groningen, Netherlands).[22] For male participants the linear factor was set at 0.069, and for female participants 0.049.

Data Analysis

Raw ECG data were edited and heart rate variability (HRV) analyses were performed using HRV Module for LabChart v1 for Windows (ADInstruments, Castle Hill, Australia). QRS complexes were identified as follows: normal, ectopic or artefact. A configurable R wave threshold detector automatically identified every heartbeat. Normal-to-normal interbeat interval (RR) intervals were calculated for HRV. Ectopic beats were replaced using linear interpolation of prior and succeeding normal intervals for the analysis. For the time domain analysis, the mean NN interval, root mean square of successive heartbeat interval differences (RMSSDs) and pNN50 were computed. The non-parametric method, spectrum of intervals, where RR intervals are re-sampled and interpolated at intervals equal to the average period, was used to determine the frequency domain.[18] The fast fourier transform (FFT) of 1024 point to overlapping segments of the resampled RR data with a Hanning window for minimal spectral leakage was applied to calculate each power spectrum for a 5 min epoch. For frequency domain analysis was quantified through power spectral density of very low frequency (VLF), low frequency (LF) and high frequency (HF).

Data is presented as mean±SD, with a two-way (motivational dominance*motivational state) repeated measures analysis of variance (two-way ANOVA) enabling comparison of variables measured for motivational dominance and state at pre-performance. Each factor had two levels including: telic dominant in a telic state (TD-T); telic dominant in a paratelic state (TD-P); paratelic dominant in telic state (PD-T); and paratelic dominant in a paratelic state (PD-P). A Tukey post-hoc analysis was performed to identify specific condition differences where a main effect was present.

All statistical analyses were performed using Prism V6.0f, Graphpad, CA, USA, significance set at $p<0.05$.

RESULTS

The paratelic dominant group scored significantly higher than the telic dominant group on total Paratelic Dominance Score (TD: 5.78±3.11; PD: 23.44±0.98; $t_{(16)}$=-16.23, $p< .001$).

The intervention to change motivational states of each group prior to performing the Wingate Test presented a significant ($F_{(9,\ 72)}$=7.134; $p<0.0001$) interaction, TSM dominance*motivational state, with a main effect difference for motivational state ($F_{(3,\ 24)}$=11.89; $p<0.0001$) but not TSM dominance ($F_{(3,\ 24)}$=0.9713; P=0.423). Post-hoc differences were identified ($p<0.05$, Figure 1) for the items: serious-playful for TD:TS *vs.* TD:PS, PD:TS *vs.* PD:PS, and TD:TS *vs.* PD:PS; planning-

Figure1: Mean±SD Scores for the Telic State Measures Test Separated for Normal-Dominant State \(telic (TD), or Paratelic (PD)) and Manipulated State. Where, refers to Significant (p<0.001) Interaction between Motivational Dominance and Motivational State; and †††† Refers to a Significant (p<0.0001) Main Effect of Motivational State.

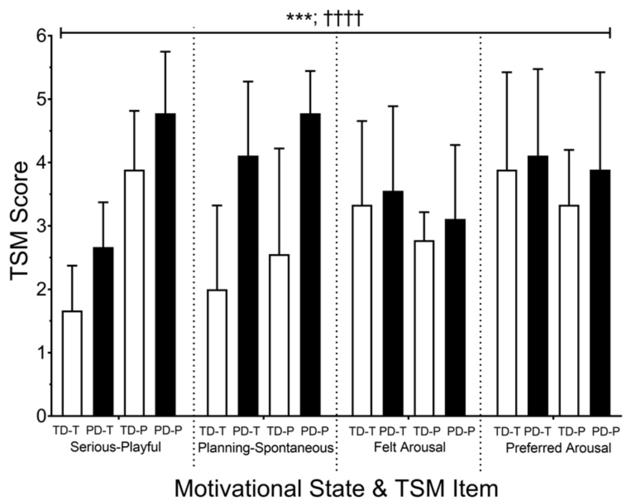

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Table 1: Mean±SD for Performance Metrics from the Wingate Anaerobic Test Under Normal-Dominant State and Manipulated State Prior to Testing.

Dominant State	Motivational State	Peak Power (W)	Mean Power (W)	Fatigue Index (%)
Telic	Telic	995±234	548±151	64.6±10.2
	Paratelic[(m)]	922±187	523±119	60.7±13.2
Paratelic	Telic[(m)]	1075±248	554±196	69.3±8.2
	Paratelic	1059±294	551±195	69.4±8.8

spontaneity for TD:TS *vs.* PD:TS, TD:TS *vs.* PD:PS, TD:PS *vs.* PD:PS.

Subsequently, performance during the Wingate Anaerobic test did not differ when comparing for motivational state ($F_{(1, 8)}$=1.027, *P*=0.341; $F_{(1, 8)}$=1.072, *p*=0.331; $F_{(1, 8)}$=0.743, *p*=0.414) or between telic or paratelic dominance ($F_{(1, 8)}$=0.678, *p*=0.434; $F_{(1, 8)}$=0.041, *p*=0.845; $F_{(1, 8)}$=3.119, *p*=0.115) for peak power, mean power or fatigue index, respectively (Table 1).

Interestingly, there were no significant (*p*>0.05) main effects of motivational dominance or motivational state on indices of the TESI (Figures 2A, 2B). In support of the TESI data, there were no statistical differences (*p*>0.05) amongst the physiological variables used (Table 2) to assess participant stress levels in either motivational state.

DISCUSSION

This study set out to examine the effects of altering telic or paratelic motivational states in order to quantify the influence on emotion, stress, and performance during all-out, short duration cycling. The main findings show that: a) There was no link between dominant motivational state and anaerobic cycle performance; b) Manipulating motivational state to the opposite state did not influence perceived levels or physiological levels of stress and did not affect anaerobic cycle performance.

Figure 2. Mean±SD Scores for the Tension and Effort Stress Inventory, Separated for Normal-Dominant State (Telic (TD), or Paratelic (PD)) and Manipulated state. A) Illustrates emotion scores, and B) Stress Scores. Where, refers to a significant (p<0.0001) main effect of TESI item.

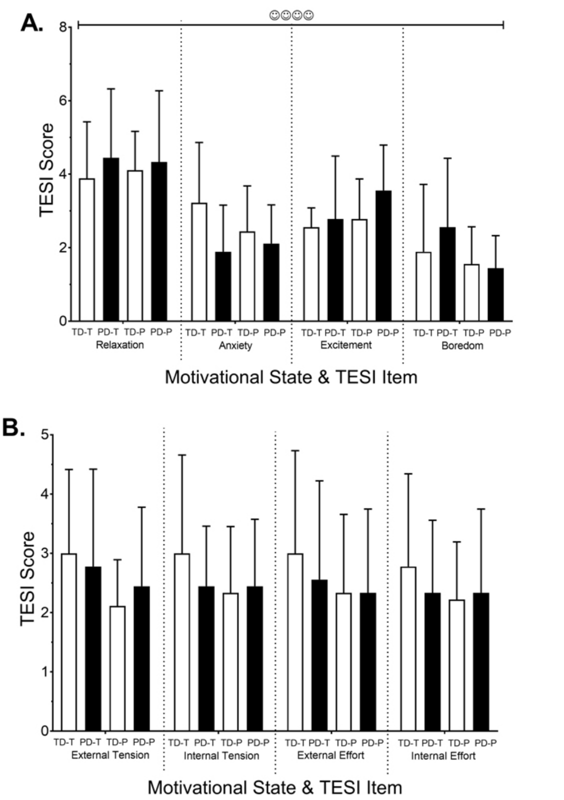

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Table 2: Mean±SD for Heart Rate and Heart Rate Variability Variables Under Normal-Dominant State and Manipulated[(m)] State Prior to Performing the Wingate Anaerobic Test.

Variable	TD-T	TD-P[(m)]	PD-T[(m)]	PD-P
Mean HR (bpm)	74±7	71±9	77±12	73±7
Mean NN (ms)	820.3±79.1	852.9±93.2	797.6±112	830.5±80.5
SDNN (ms)	45.3±14.2	48.3±8.8	46.2±17.4	54.1±15.4
RMSSD	32.87±13.5	35.6±15.3	31.2±17.0	35.3±13.2
NN50	15.2±11.6	20.9±16.5	13.6±15.4	17.5±14.7
VLF [DC-0.04Hz] (ms^2)	637± 441	995±737	901±213	1076±839
LF [0.04-0.15Hz] (ms^2)	796±438	678±434	763±528	1150±573
HF [0.15-0.4Hz] (ms^2)	434±272	496±316	420±485	538±575
LF: nu (%)	62.5±15.0	55.1±19.8	64.8±11.1	66.7±16.5
HF: nu (%)	31.6±12.7	36.2±12.8	28.9±11.1	26.6±14.6
LF/HF	2.62±1.91	2.01±1.65	2.67±1.34	3.92±3.42
LF (Normalize %)	99.1±55.6	105.0±46.3	135.5±130.2	122.2±64.1
HF (Normalize %)	86.9±39.7	91.99±16.1	129.6±127.4	140.9±96.5
LF/HF (Normalize %)	121.5±71.0	114.67±48.2	114.8±65.5	121.17±181.8

VLF: Very Low Frequency; LF: Low Frequency; HF: High Frequency; HR: Heart rate; SDNN: Standard deviation of normal to normal R-R intervals; RMSSD: Root mean square of successive heartbeat interval difference; NN: normal RR.

The results presented here further the questions raised regarding preference for physicality of sporting events and motivational states (telic *vs*. paratelic) and exercise mode. Though the trials were performed in a counter-balanced, cross-over manner, it is important to emphasise that there was no difference between performance for telic or paratelic dominant groups i.e., there was no advantage for performance measures in the Wingate test for paratelic over telic dominant groups. This is contrary to previous research that suggests that telic dominant individuals are more likely to excel in endurance events whilst paratelic dominant individuals excel in more explosive events such as the laboratory test used here.[20,23] Explanations for these findings could centre around the sensitivity of the inventories used[14] as participant groups did not differ significantly in their preferred states for scores related to emotions (relaxation, anxiety, excitement and boredom). However, the findings while not significant did suggest that the telic dominant group had higher mean values for anxiety than paratelic group at the outset of this study. High levels of this emotion have been previously suggested[8] to inhibit performance. As such it might have been expected the difference within the normal, preferred state to be even greater than normal. Likewise, the paratelic dominant group also showed tendencies for greater excitement and lower boredom pre-performance within the present study which reportedly should improve performance in all-out, short duration events. To a certain extent this did occur as peak power scores where non-significantly greater for this group, supporting links to measures of explosive, maximal exercise performance[20] associated with fast twitch muscle fibres.[15] However, the low anxiety levels in this groups would likely reduced overall performance.[9]

Individually determined motivational states (telic-paratelic) were successfully manipulated to the opposite state ("misfit effect") prior to exercise performance as per previous studies[14,24] using video stimuli. Unexpectedly, the misfit effect did not affect all-out, short duration cycle performance. As per the non-significant difference between preferred state dominance groups and performance already discussed, perceived emotions *via* assessed TESI showed no intra-group differences for relaxation, anxiety, excitement, boredom or tension and effort.[10] Again, interesting and maybe worth exploring in future work is the level of changes that occurred. Non-significant increases in boredom as a result of a decrease in excitement for paratelic dominant participants occurred but wasn't enough to alter performance. However, the non-significance finding is supported by physiological measures of stress. As such it may be prudent to focus on manipulation of arousal levels. Additionally, the manipulation of motivational state acutely as per this study is likely limited compared to long-term manipulation where changes would likely lead psychophysiological changes, hormonal in nature. As such it is envisaged there would be a greater overarching effect on performance, perceived and physiological markers of stress.

CONCLUSION

This aims of this study were to assess the effects of altering telic or paratelic motivational states in order to quantify the influence on emotion, stress, and performance during sprint exercise. The data presented shows no link between dominant motivational state and advantageous all-out, short duration cycle performance. Additionally, the manipulation of participants, motivational state to the opposite state, had no bearing on performance outcome, perceived levels or physiological levels of stress.

As such, coaches, support staff and athletes do not have to worry about a particular state in regards to telic or paratelic in an acute time frame, as long as the athlete's arousal levels and emotional conditions are optimal.

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CONFLICTS OF INTEREST

The authors declare that they have no conflicts of interest.

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