Heart rate kinetics as an indicator of recovery from cold water immersion – An investigation of both sprint and endurance exercise

C.W. Twaddell, A. Balloch, S. Roberts and S.A. Warmington, Deakin University, Centre for Physical Activity and Nutrition Research, Burwood 3125, Australia.

Introduction: Kinetics of heart rate (HR) in response to a low-intensity recovery test (LIRT) has been shown to distinguish between previous training loads and is likely explained by some adaptation to autonomic control during exercise (Nelson *et al.*, 2013). We aimed to determine whether a LIRT could be used to distinguish between acute recovery methods undertaken for repeated sprint and endurance exercise.

Methods: Participants (n = 18) were allocated to one of two experimental arms (Sprint or Endurance). Each comprised two trials (PAS and CWI) completed in a randomised cross-over design. Both trials comprised three exercise bouts (EX1, EX2, EX3) separated by a recovery period of 45 min (Ex1 to Ex2) and 24 hours (Ex2 to Ex3) during which the first 20 min was cold water immersion (for the CWI trial) or passive rest (for the PAS trial). Exercise comprised of a LIRT (5 min cycling at 100W) immediately followed by 3 × 30s Wingate sprint cycling efforts separated by 4 min rest (for the SPRINT experimental arm), or a 40 kilometre time-trial (for the ENDURANCE experimental arm). HR kinetics was examined for each LIRT according to an exponential function (Mac Ananey *et al.*, 2011).

Results: In both arms of the trial, CWI lowered HR range, specifically for EX2 in the ENDURANCE arm. Bout had an effect on baseline HR, time constant and mean response time only in the ENDURANCE arm. On the table ***** indicates main effect for condition in the SPRINT arm. ¶ indicates main effect for bout in the END arm. † denotes significantly different (p <0.017) from CON.

SPRINT	EX1		EX2		EX3	
	CON	CWI	CON	CWI	CON	CWI
Baseline HR (bpm)	72 ± 16	75 ± 14	81 ± 22	76 ± 16	84 ± 26	89 ± 17
HR Range (bpm)*	43 ± 9	39 ± 12	39 ± 11	28 ± 8	31 ± 15	30 ± 11
Time Delay (s)	0.1 ± 0.2	0.6 ± 2.1	0.0 ± 0.0	0.0 ± 0.0	0.00 ± 0.00	0.00 ± 0.00
Time constant (s)	23.1 ± 27.5	33.3 ± 25.9	85.0 ± 108.3	38.0 ± 34.8	47.4 ± 60.1	81.0 ± 80.0
Mean response time (s)	18.8 ± 17.4	33.7 ± 25.4	84.5 ± 107.7	37.8 ± 34.5	52.4 ± 61.6	80.5 ± 79.5
ENDURANCE						
Baseline HR (bpm)¶	59 ± 13	51 ± 23	64 ± 10	56 ± 27	57 ± 9	50 ± 26
HR Range (bpm)	36 ± 6	38 ± 3	38 ± 5	32 ± 6†	39 ± 2	38 ± 11
Time Delay (s)	0.7 ± 0.7	0.3 ± 0.6	1.3 ± 2.3	0.4 ± 0.9	0.7 ± 0.8	0.2 ± 0.4
Time constant (s)¶	7.4 ± 3.0	8.9 ± 5.0	12.1 ± 11.0	10.1 ± 4.7	6.4 ± 2.8	7.9 ± 4.3
Mean response time (s)¶	8.1 ± 3.4	7.9 ± 5.4	13.3 ± 13.0	8.9 ± 5.7	7.0 ± 3.0	6.9 ± 4.9

Conclusion: We conclude that a LIRT can detect changes in recovery modality through the analysis of HR kinetics, and is likely explained by increased parasympathetic activation following CWI that reduces cardio-acceleration, thereby reducing the range over which HR rises during a subsequent LIRT (Buchheit *et al.*, 2009).

Buchheit M. Peiffer J. Abbiss C & Laursen P. (2009) *American Journal of Physiology, Heart and Circulatory Physiology*, **296**, H421-27.

Mac Ananey O. Malone J. Warmington S. O'Shea D. Green S & Egana, M. (2011) *Medicine & Science in Sports & Exercise* **43**, 935-42.

Nelson M. Thomson R. Rogers D. Howe P & Buckley, J. (2013) *Journal of Science and Medicine in Sport* (online), doi: 10.1016/j.jsams.2013.02.016