THERMAL SENSATION AND AFFECT DURING WORK IN THE COLD

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INTRODUCTION

Previous research investigating the influence of environmental temperature on psychophysical sensations has largely focused on work performed in the heat, where physiological and perceptual responses are elevated above those observed in thermoneutral conditions. Such changes are generally associated with impaired worker performance. There is little data of this nature available for cold environments, though it is possible that perceptual responses to exercise may be enhanced at lower temperatures. If correct, the modification of peripheral sensory input may be used within industrial settings, to facilitate worker motivation, productivity and performance. The purpose of this study was to investigate the influence of a cold environment on both physiological and perceptual variables during exercise.

METHODS

Fourteen males (aged 22.6 $\pm$4.4 yr) performed 30 min of cycle ergometry at a constant workrate, wearing light clothing, in both thermoneutral (TN: 24°C, 50% RH) and cold (CO: 8°C, 50% RH) environments, at least 48 hours apart. The workrate was identical for both conditions, and individualized to elicit a heart rate (f_C) between 125-135 b.min^{-1} in TN. Protocol: 10 min seated rest; 5 min light cycling; 30 min constant workrate cycling; 10 min seated rest.

Baseline ratings for affect, thermal sensation, f_C, rectal (T_r) and skin temperatures ($\bar{T}_{sk}$: 8 sites) were obtained in the TN state prior to commencing each session. Affect and thermal sensation were recorded every 3 min, while the physiological variables were sampled at 1 min intervals. Affect was derived using the 10-point bipolar scale of Hardy and Rejeski (1989: +5 = 'very good'; -5 'very bad'), in response to the question "How are you feeling?". Thermal sensation was determined after Gagge *et al.* (1967: 1 = cold; 7 = hot), by asking "How does the temperature of your body feel?".

RESULTS

Environmental conditions influenced both perceptual and physiological status, with subjects feeling better (affect) and cooler, and having lower f_c and $\bar{T}_{sk}$ in the cooler environment (Figure 1).

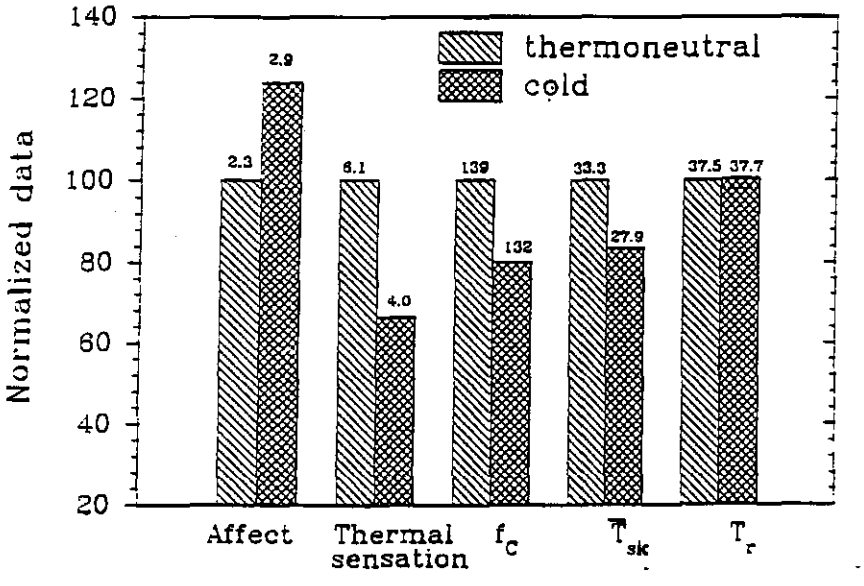

Figure 1: Mean physiological and perceptual responses during neutral and cold exposures. Data averaged across time, and expressed as a percentage of thermoneutral value (absolute values indicated on bars).

T_r was not different between conditions ($p > 0.05$), however, both f_c and $\bar{T}_{sk}$ differences over time were significant ($p < 0.05$). Thus, the CO state depressed the f_c response despite the equivalent workrates. Exercise in the TN state lowered affect, inducing a parallel displacement of the affect curve, moving towards neutral affect by approximately 0.6 points from the pre-exposure baseline ($p < 0.05$). Thermal sensation was influenced by both exercise and environment, with sensation becoming 'hotter' (increasing) as the exercise period continued. Thermal sensation ratings in the CO were consistently lower ($p < 0.05$), but remained parallel with those observed for the TN condition. Changes in thermal sensation during exercise appeared to be unrelated to either T_r and $\bar{T}_{sk}$, however, in the CO there was a significant positive correlation between thermal sensation and forehead T_{sk} ($p < 0.001$; Figure 2), and a significant negative correlation between thermal sensation and f_c ($p < 0.01$).

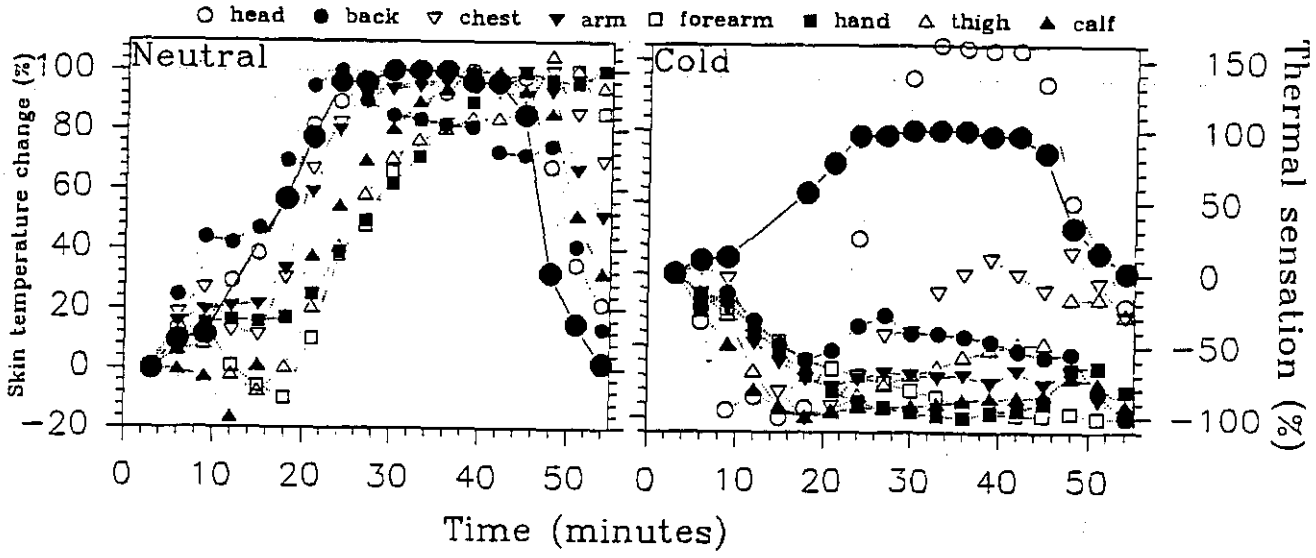

Figure 2: Thermal sensation (large ●-●) and local skin temperature responses during a rest:work protocol in thermoneutral and cold exposures.

DISCUSSION

Given that some industries require workers to perform physical tasks in thermally stressful environments, and that attempts to minimize the effect of this combination of stressors is not always effective, the need exists to identify ways in which worker motivation, productivity and performance may be enhanced. The CO state was both physiologically and perceptually less stressful, as anticipated. One cannot simply replicate these conditions in the workplace, though through the use of various gas and liquid perfusion garments, the effect of heat loading may be ameliorated. Such garments are both expensive and cumbersome, and are often not used where thermal stress is deemed marginal. Given the present correlation between forehead T_{sk} and thermal sensation, one is tempted to suggest that thermal sensation, and perhaps psychological well being and work performance, may be modified by changes in local body temperature, both with and without the use of perfusion garments.

REFERENCES

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2. Gagge, A.P., Stolwijk, J.A.J., and Hardy, J.D. 1967 Comfort and thermal sensations and associated responses at various ambient temperatures. *Environmental Research* 1, 1-20.