Quantification of the Motivation to Behaviorally Thermoregulate during Passive Heat Exposure in Humans

Julia R. Slyer, Nicole T. Vargas, Christopher L. Chapman, Blair D. Johnson, Jennifer L. Temple, Elizabeth G. Mietlicki-Baase, Zachary J. Schlader

Center for Research and Education in Special Environments, Department of Exercise and Nutrition Sciences, University at Buffalo, Buffalo, NY, USA

Abstract

Purpose: Motivation plays a key role in the decision to initiate a change in behavior. Animal models employing operant techniques indicate that the motivation to behaviorally thermoregulate is dependent on the magnitude of changes in body temperature. Similarly, behavioral thermoregulation in humans is driven by the extent of changes in skin and/or core body temperatures. However, human motivation to behaviorally thermoregulate has not been quantified in humans. Therefore, we tested the hypothesis that the motivation to behaviorally thermoregulate in humans is dependent on the magnitude of changes in body temperature.

Methods: Following 10 min of seated rest in a 24.1 ± 0.8°C environment, ten healthy subjects (22 ± 3 y, 5 females) underwent 60 min of seated rest in a 32.2 ± 0.6°C (T32) or 42.3 ± 0.7°C (T42) environment (20% relative humidity). Trials were completed in a counterbalanced order separated by one week. The motivation to behaviorally thermoregulate was measured using operant responding on a fixed ratio schedule, in which subjects received thermal reinforcement after clicking a button 100 times. The reinforcer was 30 s of cooling on the dorsal aspect of the neck, an area highly sensitive to cooling during heat exposure. Cooling was enabled via a custom-made device in which tubing was perfused with -20°C fluid. Behavioral thermoregulation was defined as the change in neck skin temperature and the motivation to behave was defined as the cumulative number of button clicks over time. Neck skin, weighted mean skin (10 site), and intestinal temperatures were measured continually. Data are presented as mean ± SD.

Results

- Mean skin temperature (10 site)
- Intestinal temperature
- Mean body temperature
- Neck skin temperature

PRIMARY DEPENDENT VARIABLES:

- Mean skin temperature (10 site)
- Intestinal temperature
- Mean body temperature
- Neck skin temperature

Mean skin temperature (10 site)

**Figure 1:** Subject setup.

**Figure 2:** Operant response task using a fixed ratio schedule. Shapes changed with each click and matched after 100 ± 5 clicks, at which point when cooling was earned.

**Figure 3:** Custom-made dorsal neck cooling device perfused with -20°C fluid.

**Figure 4:** Mean Skin Temperature (°C) vs Time (min).

**Figure 5:** Intestinal Temperature (°C) vs Time (min).

**Figure 6:** Mean Body Temperature (°C) vs Time (min).

Conclusions

- These data indicate that the motivation to receive thermal reinforcement during heat exposure is likely dependent on the magnitude of changes in mean body temperature.
- Thus, in support of previous animal data, the motivation to behaviorally thermoregulate in humans is dependent on the magnitude of changes in body temperature.