The Hunting Reaction: An Investigation of Thermoregulation in the Hand

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Thermoregulation and the Hunting Reaction

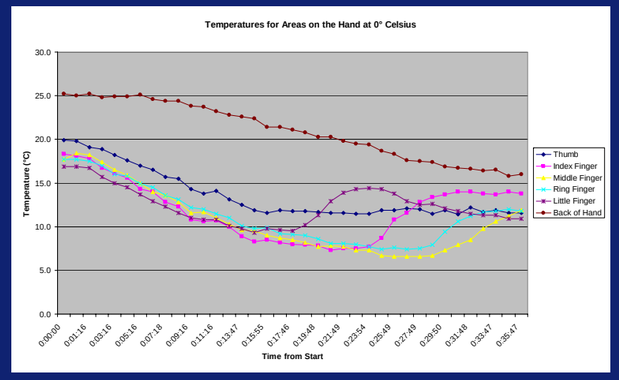
Over the course of history, humans have adapted to and even thrived in the most extreme conditions, from the sweltering heat of the Sahara to the numbing cold of the Arctic. One of the reasons for this versatility is the body's ability to regulate temperature, especially in the cold. This study explores the mechanism of alternating vasoconstriction and vasodilation, known as the Hunting Reaction, one of the many mechanisms of thermoregulation.

The body has many varied methods of temperature regulation. Metabolic responses to cold include shivering and non-shivering methods of thermogenesis, such as increased metabolism, the tensing of muscles, and muscle stiffness (Parsons, 1993). In contrast, vasomotor responses reduce heat lost to the environment by means of vasoconstriction and vasodilation, including the phenomenon known as the Hunting Reaction. This is a phenomenon in which the blood vessels in areas most prone to cold-injury, such as the hands and forearms, alternately constrict and dilate to minimize heat lost to the environment, while at the same time preventing the tissue from freezing and causing cold injuries such as frostbite (Marriott et al., 1996). When the skin temperature falls below about 2°C (Marriott et al., 1996) sensors in the skin of the hand and muscles in the forearms relay the message to the hypothalamus, which then begins to trigger vasoconstriction that becomes maximal when the skin temperature is about 0°C (Marriott et al., 1996) . Because the skin can only tolerate the reduced blood flow for a limited amount of time due to potential for injury from oxygen and nutrient deprivation (Ashcroft, 2000) as well as cold, the vessels eventually dilate, and this pattern of constriction and dilation continues, conserving heat while protecting the extremities from injury (Marriott et al., 1996).

Our experiments are attempting to track the temperature of the hand over a range of ambient air temperatures using an infrared camera to gain a better understanding of how cooling and the Hunting Reaction occur. Most previous tests have been done with temperature sensors in a cold water bath (Jobe et al., 1985, Marriott et al., 1996), so this experiment is an attempt to compare the results of previous experiments with an analysis of the entire hand in varying air temperatures, similar to the conditions to which people would be exposed in the field.

The very first trials of this experiment were conducted at -6.7 °C, -11 °C , and -18 °C. The data collected showed very little evidence of the Hunting Reaction, due in part to technical difficulties with the infrared camera, and possibly also because of the low temperatures, as the literature reports that if the skin temperature drops too low, surface blood vessels restrict continuously and the extremities then cool to the environmental temperature (Ashcroft, 2000).

The experiment was then adapted and trials were run at -7 °C and 0 °C using a different infrared camera. Not only did these trials show evidence of the Hunting Reaction (see figure below), but different rates and patterns of cooling and re-warming in the fingers were observed, and the appearance of blood vessels was also noted. These observations, however, did not occur until about 17 minutes into the trial, and on several fingers, remained until the trial was completed at roughly 35 minutes. This data varies rather significantly from the literature values reporting evidence of the Hunting Reaction at 7 to 10 minutes (Jobe, 1985), however, the previous trials we have found have been conducted by immersion of a single finger in cold water. Because of the much higher convective heat transfer from immersion in water versus air this result is not unexpected.



Further trials will be conducted and, ultimately, the goal of this experiment is to investigate the patterns of warming and cooling of the hand—especially vasoconstriction and vasodilation—in conditions similar to those encountered in the field to gain a better understanding of the effects of the cold, and thus be able to better protect against it.

Image at time 30:18

Note light color of index finger and localized point on middle finger signifying a warmer temperature in contrast to the dark color of the remainder of the middle finger Also note the blood vessels visible as darker lines on the back of the hand

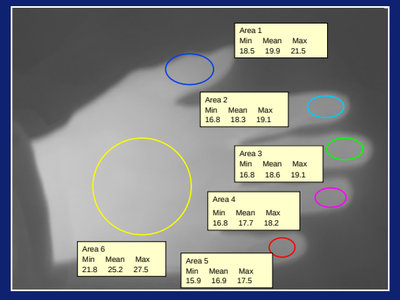


Image at time 0:00 with analysis

Note uniformity in the color of the hand indicating a uniform temperature

References:

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