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THE CALCULATION OF MEAN HAND SKIN TEMPERATURE IN  
STUDIES OF MANUAL PERFORMANCE IN THE COLD

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October 1959

HEADQUARTERS QUARTERMASTER RESEARCH & ENGINEERING COMMAND, US ARMY  
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ENVIRONMENTAL PROTECTION RESEARCH DIVISION

Research Study Report

PB-29

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Project Reference:  
7-83-01-006

October, 1959

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# THE CALCULATION OF MEAN HAND SKIN TEMPERATURE IN STUDIES OF MANUAL PERFORMANCE IN THE COLD

## 1. Introduction

The relationship between hand skin temperature and manual performance has been studied under several experimental conditions, (1, 2, 3, 4, 5). In the most recent of these studies, (1), criterion hand skin temperatures were calculated as "weighted" means of two thermocouple readings, one reading having been obtained from each of S's fifth fingers. However, differences as great as 30° F have been found at times between the skin temperatures of S's hands during cooling. When such differences occur, criterion skin temperatures at which S is to perform should be calculated as simple arithmetic averages only if it can be shown empirically that each hand contributes equally to performance. If it were found that the preferred hand is more important in the standard task, then criterion skin temperatures should be calculated as means weighted appropriately in favor of the preferred hand. Specifically, if it can be shown that performance duration increases above that obtained at normal skin temperature by "x" times when only the preferred hand is cooled and by "y" times when only the non-preferred hand is cooled, then the skin temperatures of these hands may be weighted by "x" and "y", respectively, in calculating the criterion hand skin temperatures. The purpose of the present study was to determine whether or not these weights are necessary and, if so, to obtain them.

## 2. Method

### a. Conditions Common to Both Practice and Test Sessions

Twenty white enlisted men, dressed in shorts and shoes, were exposed to a constant ambient temperature of 70° F and 50% relative humidity while their hands were inserted into a cooling box. Criterion hand skin temperatures and performance on the two-hand knot-tying task were measured as in the Clark and Cohen study (1).

The Ss were not permitted to eat after a 2400 hours bed-check until they had been run. "Black" coffee was allowed, however, at any time prior to running. These restrictions on food consumption made it necessary to run all Ss as early in the day as possible. Therefore, the subject sample was divided into four equal groups and one group was run per week. Each man within a group was assigned one of the hours from 0800 to 1300 and was run at that time each day for five days.

b. Practice Session

The first two days of the five-day experimental week were practice days during which S tied thirty sets of fifteen knots each day. During practice, S tied knots in the cooling box while the door of the box was left open exposing the hands to the ambient conditions.

c. Test Session

The test session lasted three days and on each day S was cooled according to a different experimental condition. On the first test day, half of the Ss had their preferred hands cooled and half their non-preferred hands. On the second test day, all Ss had both hands cooled. On the third test day, the procedure of the first day was reversed, allowing for the elimination of practice bias from the data. During the days when only one hand was cooled, the skin temperature of the other hand was maintained at 90° F with the aid of an electrically heated muff. The warmed hand entered the cooling box only to assist the cooled hand during performance on the knot tying task. Each test day, S tied one set of fifteen knots at four criterion hand skin temperatures: (1) after both hands had been warmed to 90° F and then inserted into the cooling box, (2) after the skin temperature of the cooling hand, or hands, had fallen to 55° F, (3) to 45° F and finally (4) to 40° F.

3. Results

The results are summarized in Table I. The comparisons of major interest are those between cooled preferred and non-preferred hands at the four criterion hand skin temperature levels. The differences found are too small to be of practical interest to the experimenter because he could not, with the use of presently available apparatuses, make such small adjustments in skin temperature recordings; the adjustments would fall within the experimenter's error of reading the graphic charts of skin temperature. In addition, the differences that do appear would be expected due to chance variation alone and, in this sense, are not reliable differences at all.

Table I

Mean times (sec.) to tie fifteen knots at four criterion temperatures for the three hand cooling conditions

Cooling Condition	Hand Skin Temperature			
	90°	55°	45°	40°
Preferred Hand	31.7	34.4	35.9	39.5
Non-preferred Hand	31.6	34.1	34.8	39.4
Both Hands	31.4	34.2	38.6	43.3

#### 4. Conclusions

With regard to the "x" and "y" multipliers spoken of in the introduction section of this paper, the data indicate that "x" = "y". Therefore, we have empirical support for the procedure of equal weighting of the skin temperatures obtained on each of S's fifth fingers in the calculation of criterion skin temperature means.

#### 5. References

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