Modification of thermoregulatory responses to cold by hypnosis

ABBOTT T. KISSEN, CLIFFORD B. REIFLER, and VICTOR H. THALER
Aerospace Medical Research Laboratories, Aerospace Medical Division, Air Force Systems Command, Wright-Patterson Air Force Base, Ohio

Physiological activities which serve to maintain body temperature within its normal range have been noted to occur in response to stimuli generated by both central and peripheral control mechanisms. Shivering, as one example, has been observed to be associated with alterations of rectal temperature (37) and brain temperature (35); the implication being that brain (specifically hypothalamic) temperature exercises a "central" control over shivering. Other studies (17, 20) have demonstrated that it is alterations in skin temperature which are responsible for the initiation of shivering. The predominant role of the peripheral mechanism in the initiation of shivering has been stressed by Lim (27). Helmdach and Meehan (16) noted that the thermoregulatory responses of dogs were affected by alterations of peripheral sensitivity wherein depression of peripheral thermosensitivity increased the amount of skin cooling required to initiate shivering. A crucial factor in such homeostatic control of thermoregulatory mechanisms is apparently vasomotor activity.

Psychogenic influence of peripheral vasomotor activity is frequently observed in most instances of facial blushing and pallor. There is evidence of similar responsivity of the peripheral vasomotor mechanism to hypnotic suggestion (7). Reactivity of other aspects of the vasomotor mechanism, such as thermal and tactile receptors, may also be affected by hypnotic suggestions.

In view of the interrelationship of the peripheral vascular mechanism and thermoregulation, and the possibility of influencing these by hypnosis, it seemed probable that the utilization of hypnosis in a biothermal stress study would provide both a novel and productive approach to the study of thermoregulation. The following is a report on the modification of shivering, temperature, and related responses in human subjects exposed to whole-body cold stress in the hypnotic state.

PROCEDURE

Forty experiments were conducted on five healthy non-acclimatized male subjects whose physical characteristics are shown in Table 1. The sitting-resting subjects, wearing 1.0 clo body insulation, were exposed to an ambient air temperature of 4 ± 0.5°C for 60 min. Preceding each exposure the subjects were thermally equilibrated at room temperature (25-27°C) for 1 hr. Control recordings were obtained during the last 5 min of this pre-exposure period. In experimental exposures, the trance induction was begun after 30 min of equilibration and continued for the remainder of the control period. Each subject completed eight tests, four of which were nonhypnotized exposures, the remainder, in an induced trance. There was no insulation on head or hands, and leather shoes and light cotton socks were worn. Air-wall temperatures were
TABLE 1. Subject characteristics

<table>
<thead>
<tr>
<th>Sub</th>
<th>Age, yr</th>
<th>Occupation</th>
<th>Height, cm</th>
<th>Weight, kg</th>
<th>Surface Area, m²</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>21</td>
<td>Airman</td>
<td>173.5</td>
<td>66.3</td>
<td>1.82</td>
</tr>
<tr>
<td>H</td>
<td>21</td>
<td>Student</td>
<td>177.5</td>
<td>77.7</td>
<td>1.95</td>
</tr>
<tr>
<td>D</td>
<td>20</td>
<td>Student</td>
<td>168.9</td>
<td>57.8</td>
<td>1.66</td>
</tr>
<tr>
<td>K</td>
<td>19</td>
<td>Student</td>
<td>183.0</td>
<td>52.6</td>
<td>1.55</td>
</tr>
<tr>
<td>A</td>
<td>20</td>
<td>Student</td>
<td>190.0</td>
<td>76.5</td>
<td>2.05</td>
</tr>
</tbody>
</table>

Shivering response. Under nonhypnotized conditions, onset of subject shivering was variable, usually beginning as gross tremors within the first 5 min of cold exposure. There were, however, marked shivering responses in all nonhypnotized conditions prior to 30 min of exposure. Once begun, shivering continued, phasically, for the remainder of the test period with increasing frequency and peak amplitude. In addition to the gross shivering response, the subjects displayed behavior responses indicative of extreme discomfort. These included grimacing, exertive sounds, and deliberative, gross body movements. All subjects when under nonhypnotized conditions expressed immense relief upon cessation of the experiment and invariably registered complaints of discomfort, particularly of finger pain.

The same subjects exposed to the same environmental manipulation but in a hypnotized state responded quite differently ($P < .001$; Fig. 1). By the end of the experiment, shivering was reduced to less than one-third of the nonhypnotized values. In some subjects there was
absolute absence of tremor throughout the entire hypnotized exposure period. Shivering, when evident, was markedly delayed, occurring, generally, within the last 10 min of the experiment. Facial expressions were markedly impassive and breathing was relatively regular and shallow. Upon return to room temperature and arousal from trance, the subjects, with rare exception, reported a subjective shortening of exposure time and definite lack of difficulty in tolerating the conditions. While there were isolated references to finger discomfort, these remarks were never spontaneous, but rather in response to specific requests for recall.

Vigilance task. Vigilance performance scores registered by subjects under both hypnotized and nonhypnotized states were tested for statistical significance. These scores reflected three aspects of vigilance performance: correct responses, errors of omission, and errors of commission (Fig. 2). Despite large individual variations, significant improvement (P < .01) in the accomplishment of this task was demonstrated by subjects under hypnotized conditions during the last half of the exposure time. This improvement was manifested in terms of both increased correct responses and decreased errors of omission. There was no difference in scores relating to errors of commission.

Basal skin resistance. There is a consistent and significant difference in the BSR responses elicited by subjects under hypnotized and nonhypnotized conditions (Fig. 3). Regardless of initial relationships, after 15 min of exposure the mean BSR values of subjects measured under hypnotized conditions were higher than those of nonhypnotized exposures. This difference progressively increased for the remainder of the exposure period with a terminal mean difference of almost 18,000 ohms.

Heart rate. In four of the five subjects, a relatively lower heart-rate trend was established during hypnotized conditions at or before 15 min of exposure time. This trend was consistent throughout the exposure period and the difference was intensified progressively (Fig. 4). Statistical treatment of the data for all subjects indicates a significantly reduced heart rate under hypnotized conditions (P < .01). Both the relative decrease and the absolute values for heart rate at the conclusion of the experimental exposure show significant differences (P < .01) between conditions (Table 2).

Heat loss (−Q). Heat loss, expressed as caloric loss per square meter per hour is shown in Fig. 5. All hypnotized condition exposures elicited higher heat loss rates throughout the experiment as compared to their nonhypnotized controls. The mean −Q, for all hypnotized runs at the termination of the exposure was 103 Cal/m² representing an increased heat-loss rate of approximately 15 Cal/m² per hour.

Skin temperature. With the exception of the scapular area, none of the 17 individual thermistor placements showed significant skin temperature differences between hypnotized and nonhypnotized conditions. There was some tendency for the "weighted mean skin temperatures" of the two groups to diverge, with maximum disparity occurring at the conclusion of the exposure period. Terminally this amounted to a 0.28 C difference, with the hypnotized condition being lower. Statistical analysis of this however fails to demonstrate significance (Table 3).
Upon abrupt exposure to cold, the skin and mean body temperatures of human subjects began to fall at once (in spite of, and perhaps causing, the rise in core temperature). The subjects evidenced vasoconstriction and shivering. It was concluded that the regulatory system was operating under a strong drive from the skin receptors and in an opposite direction from that which the increased core temperature would have driven. Lim (27) demonstrated the existence of "peripheral" in addition to "pure central" shivering produced by local cooling of the hypothalamus. This study also emphasized the predominant role of the peripheral mechanism in the initiation of shivering and the conclusion was drawn that thermal stimuli originating at the cutaneous thermoreceptor level are at least as effective and probably more potent than central or core temperature.

Hardy (14) has said, "It has not been possible in animal or man to obtain data on a subject devoid of cutaneous sense of warmth or cold. Were it possible to find a man so deficient, headway could be made in closing an important gap in our knowledge." Acceptance of the concept of the major role of cutaneous sensory input in thermoregulation leads one to interesting speculations regarding the alteration of normal thermoregulatory responses by modification of the peripheral mechanism. It is our feeling that in a sense and, to at least a limited extent, we are dealing with such a modification in the hypnotized subject.

Discussion of the involvement of hypnosis in thermoregulatory investigation should be prefaced by an

**RECTAL TEMPERATURE.** The pattern of rectal temperature response of subjects while under nonhypnotized conditions exhibited less consistency than did the pattern under hypnotized conditions. During nonhypnotized runs two subjects showed modest, but consistent, mean increases in rectal temperature (0.11 and 0.33 C). Rectal temperatures for the remaining subjects tended to fall during nonhypnotized exposures, the decrease ranging from 0.22 to 0.39 C. Rectal temperature responses in the hypnotized exposure were more uniform in that all subjects experienced a decrease (0.17 to 0.78 C) with a mean fall of 0.56 C for the group. Comparisons of these temperatures across time show a consistent trend of increasing difference between mean hypnotized and nonhypnotized values. At the last 5-min intervals, these differences are significant beyond the 1% level of confidence (Fig. 6).

**FIG. 3.** Mean basal skin resistance. Areas enclosed in rectangle represent data showing significant difference between conditions (P < .01).

**FIG. 4.** Mean heart rate—absolute values. Areas enclosed in rectangle represent data showing significant difference between conditions (P < .01).
acknowledgment of its limitations. Any study which utilizes hypnosis as a research tool is, at the outset, hampered by the difficulties of quantitating characteristics of the trance phenomenon. Despite numerous attempts, there is widespread disagreement as to the reliability and validity of any one system (LeCron (23), Hatfield (15), Witzenhoffer and Hilgard (40), Shor (35), Barber and Calverley (3), see also Jenness (19)). Other difficulties appear in relation to comparing effects of hypnosis on a particular parameter without specifying the over-all conditions which apply. We feel it is important to study the effect of hypnosis upon a functioning system rather than upon an isolated response. In this way hypnotic effect can be studied as an intervening condition which is expected to modify a pattern of response produced by a primary alteration of normal biological mechanisms. In this case, the pattern of response elicited by cold exposure is relatively constant and is related to basic physiological homeostatic mechanisms of the organism. How the organism will respond to the imposed stress can be quantified. How this ongoing homeostatic response is altered by the experimental interjection of hypnosis can then be compared to the original dynamic alteration.

This was an exploratory study, however, to determine the effectiveness of hypnosis as a research tool in thermoregulatory investigation. We are, therefore, not at this time concerned as much with the nature of the hypnotic alteration as we are in determining whether such an alteration can be achieved. For this purpose we maximized the intensity of those techniques usually characterized as "hypnotic" in an attempt to determine feasibility of the approach. On the basis of our data, we propose that hypnosis is effective in modifying the normal thermoregulatory response pattern of the non-acclimatized man, at least when acutely exposed to the level of cold stress specified in this study.

With the exception of von Eiff's study (38) on the influence of hypnosis on temperature sensation and heat control, we have been unable to uncover any other reports pertinent to the unique conditions of this investigation. Von Eiff studied three females and two males at 12°C and a different group of four males and one female at 0°C. Subjects had varying levels of hypnotic training, were exposed once to the cold while under hypnosis and a The rectal temperatures of subjects hypnotized were 37°C and a different group of four males and one female at 0°C changes under hypnotized and nonhypnotized conditions. Length of the exposure to 12°C was 45 min for females; for the 0°C condition the exposure was 20 min and 15 min, respectively. Additional

**TABLE 2. Change in heart rate**

<table>
<thead>
<tr>
<th></th>
<th>H</th>
<th>NH</th>
<th>HLHY</th>
<th>Significant HLHY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-exposure</td>
<td>83.0 ± 4.6</td>
<td>80.9 ± 4.9</td>
<td>2.12</td>
<td>NS</td>
</tr>
<tr>
<td>Plasma 5 min</td>
<td>68.3 ± 7.3</td>
<td>73.9 ± 6.0</td>
<td>5.55</td>
<td><em>p &lt; .05</em></td>
</tr>
<tr>
<td>Post-exposure</td>
<td>44.4 ± 7.0</td>
<td>7.02 ± 3.0</td>
<td>7.047</td>
<td><em>p &lt; .05</em></td>
</tr>
<tr>
<td></td>
<td><em>p &lt; .01</em></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

major differences in experimental procedure were that von Eiff's subjects wore virtually 0-clo insulation (bathing suits) and apparently were given direct suggestions of warmth, opposite to the prevailing environmental conditions, rather than permissive or indirect suggestions of comfort. Von Eiff also had his subjects "under four blankets for one-half hour" prior to exposure for the purpose of obtaining control values for O2 consumption and temperature. The O2 consumption did not appear significantly altered by hypnosis in the 12°C exposure; in the 0°C exposure the increase in O2 consumption occurring under nonhypnotized conditions was significantly reduced to the point of being nonexistent under hypnotized conditions.

Despite these differences—particularly the amount of insulation worn and the length of exposure, which may serve to compensate for each other's opposite effects—our findings with respect to skin and rectal temperature changes under hypnotized and nonhypnotized conditions are in essential agreement with those of von Eiff. The rectal temperatures of subjects hypnotized were lower than those of the same subjects under nonhypnotized conditions (von Eiff gives data on this only for his 0°C exposure). We were both unable to detect significantly different skin surface temperatures between the hypnotized and nonhypnotized conditions. Finally, we are in agreement that, at least on the basis of subjective reporting, hypnosis is capable of amelioration and even suppression of the general sensation of cold. We believe that the authenticity of these subjective responses is supported by other objective findings to be discussed.

In addition to the performance variable, quantitative measures of heat loss, heart rate, and shivering give added dimension and explanation to von Eiff's finding of decreased oxygen consumption under the more severe
and physiological sleep, but also to provide a constant monitor of the subject's psychic state in terms of his ability to maintain contact with his environment. The interesting result of this measure is that not only was there no decrement (and assumed loss of awareness and ability to function adequately), but rather subjects were improved in their performance under hypnosis.

It is tempting to relate this effect to a dissociation of the effects of the cold from the task at hand. The possibility also exists, however, that the improved performance is due to the removal of mechanical interference because of severe shivering. It is unfortunate that no data are available concerning the performance under nonstress conditions (i.e., room temperature) to indicate whether this is a relative or absolute improvement. However, the lever was attached to a microswitch which required minimal pressure to operate; and, in general, the improvement also occurs in a period of time when severe shivering is not generally present.

In attempting to arrive at an over-all appraisal of the data we are impressed by the remarkable similarity in the response of our hypnotized subjects, acutely exposed to cold stress, with those reported for naturally and artificially cold-acclimatized men. Davis and Joy (8) have observed that shivering was virtually abolished in both seasonal and chamber cold-acclimatized men. They also add that not the least striking manifestation of acclimatization was the observed change from marked subjective discomfort of the subject early in the study to rather complete tolerance of, and indifference to, the cold at the end of the study. Irving et al. (18) found that Arctic Indians manifest significantly lowered rectal temperature during cold exposure. In this sense they duplicate the rectal temperature decline of nomadic Lapps (1) and the Australian aborigines (34) observed under similar environmental conditions. With the exception of the Arctic Indians the other native groups shivered less than Caucasian controls, or not at all. All of the native groups demonstrated greater tolerance to the exposure by sleeping longer and resting more comfortably than non-acclimatized subjects. Meehan (29) has presented similar findings in comparative exposures of Eskimos and Caucasians to cold. The relatively lower rectal, body, and trunk temperatures of the Eskimos are comparable in direction and magnitude to the related temperatures of our hypnotized subjects. The increased shivering response and greater conservation of body heat demonstrated by Meehan's native subjects is not, however, reproduced by our hypnosis group.

We are convinced that the subjects described in this study, when hypnotized, respond to cold exposure in a manner significantly different from their response to the same exposure in the nonhypnotized condition. They demonstrate at least a type of adaptation in the generic sense. Eagan (11) has presented a schema which attempts to categorize the effects on organisms of changes in thermal environments. Of the various subdivisions of adaptation suggested, habituation, specifically, cold

Table 3. Skin temperatures; initial and terminal values

<table>
<thead>
<tr>
<th>Position</th>
<th>Initial Mean T (°C)</th>
<th>Initial SD</th>
<th>Diff Mean T (°C)</th>
<th>Diff SD</th>
<th>Terminal Mean T (°C)</th>
<th>Terminal SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forehead</td>
<td>34.88</td>
<td>0.31</td>
<td>25.38</td>
<td>0.24</td>
<td>26.33</td>
<td>0.30</td>
</tr>
<tr>
<td>Neck</td>
<td>34.61</td>
<td>0.21</td>
<td>29.69</td>
<td>0.18</td>
<td>29.82</td>
<td>0.23</td>
</tr>
<tr>
<td>Scapula</td>
<td>34.17</td>
<td>0.37</td>
<td>27.52</td>
<td>0.30</td>
<td>26.38</td>
<td>0.15</td>
</tr>
<tr>
<td>Kidney</td>
<td>32.85</td>
<td>0.06</td>
<td>26.56</td>
<td>0.08</td>
<td>25.94</td>
<td>0.14</td>
</tr>
<tr>
<td>Nipple</td>
<td>34.19</td>
<td>0.25</td>
<td>30.16</td>
<td>0.23</td>
<td>29.61</td>
<td>0.15</td>
</tr>
<tr>
<td>Abdomen</td>
<td>34.87</td>
<td>0.30</td>
<td>29.68</td>
<td>0.25</td>
<td>29.43</td>
<td>0.25</td>
</tr>
<tr>
<td>Rump</td>
<td>32.30</td>
<td>0.30</td>
<td>22.87</td>
<td>0.28</td>
<td>21.91</td>
<td>0.30</td>
</tr>
<tr>
<td>Upper Arm, Right</td>
<td>33.67</td>
<td>0.35</td>
<td>25.58</td>
<td>0.28</td>
<td>25.30</td>
<td>0.28</td>
</tr>
<tr>
<td>Lower Arm, Left</td>
<td>33.95</td>
<td>0.33</td>
<td>24.97</td>
<td>0.30</td>
<td>25.77</td>
<td>0.28</td>
</tr>
<tr>
<td>Hand, Right</td>
<td>35.04</td>
<td>0.99</td>
<td>24.13</td>
<td>0.15</td>
<td>23.20</td>
<td>0.07</td>
</tr>
<tr>
<td>Hand, Left</td>
<td>35.23</td>
<td>0.35</td>
<td>25.34</td>
<td>0.55</td>
<td>25.90</td>
<td>0.09</td>
</tr>
<tr>
<td>Ant. Thigh, Right</td>
<td>33.38</td>
<td>0.65</td>
<td>25.99</td>
<td>0.30</td>
<td>25.90</td>
<td>0.09</td>
</tr>
<tr>
<td>Post. Thigh, Left</td>
<td>32.72</td>
<td>0.50</td>
<td>25.23</td>
<td>0.23</td>
<td>25.00</td>
<td>0.23</td>
</tr>
<tr>
<td>Skin, Neck</td>
<td>32.36</td>
<td>0.32</td>
<td>25.13</td>
<td>0.40</td>
<td>24.53</td>
<td>0.30</td>
</tr>
<tr>
<td>Calf, Left</td>
<td>32.77</td>
<td>0.18</td>
<td>25.19</td>
<td>0.28</td>
<td>25.19</td>
<td>0.40</td>
</tr>
<tr>
<td>Leg, Right</td>
<td>32.88</td>
<td>0.22</td>
<td>20.07</td>
<td>0.51</td>
<td>19.46</td>
<td>0.61</td>
</tr>
<tr>
<td>L. Foot</td>
<td>32.89</td>
<td>0.13</td>
<td>19.60</td>
<td>0.18</td>
<td>19.42</td>
<td>0.18</td>
</tr>
<tr>
<td>Weighted Mean Skin</td>
<td>33.45</td>
<td>0.34</td>
<td>24.93</td>
<td>0.30</td>
<td>24.63</td>
<td>0.30</td>
</tr>
</tbody>
</table>

* Statistically significant temperature difference (P < .01).
habituation, seems to describe most satisfactorily the response of hypnotized subjects. Eagan further categorizes cold habituation as being specific or general. Of these, we identify our results with the latter category. Eagan defines general cold habituation as "a change in the psychological set of the organism relevant to the repeated stimulus and the conditions incidental to its application (resulting in) a diminution in a physiological effect or response to the stimulus." The essential difference still remaining between the habituation described above and our results is of a temporal nature. The altered thermoregulatory response of hypnotized subjects is evident in the first acute exposure and the change in psychological "set" is not dependent upon the repetition of stimuli over an unspecified period of time. It is as if cold habituation had been accomplished instantly.

This "instant habituation" which our subjects evidenced while under hypnotized conditions is also reminiscent of the pharmacological effects of several drugs with psychoactive properties—particularly chlorpromazine (Thorazine) (39). The immediate but transient effect of our hypnotized conditions can be likened to the effect which might be elicited from such a drug administration. The subjective responses of the subjects (as well as the physiological measures) all indicate an effect of "tranquilization" consistent with the action of this particular drug, including the adrenolytic effect and suppression of shivering (10).

An explanation of the mechanism operative in hypnosis which is capable of altering the usual pattern of thermoregulatory responses cannot be completely generated from this study. Thermal regulation in man (5) can be ascribed, essentially, to two methods of control. Changes in heat production constitute what has been called "chemical" control and is so designated in view of the fact that all the heat produced in the body has its primary origin in chemical processes that occur in the tissues. On the other hand, bodily changes that alter the exchange of heat between the body and the environment are properly referred to as "physical" methods of control. Unfortunately, metabolic rate and plethysmographic measurements, so highly relevant in delineating these factors, were not performed in this study. In addition, efforts to explain the results obtained here are hampered by the insufficiency of information concerning the mode of operation of hypnosis in such a physiological alteration. Some of the questions which remain unanswered are as follows: To what extent, if any, is the central nervous system, particularly the cortical area, involved under these conditions? Delgado and Livingston (9) have shown in the monkey that bilateral removal of the posterior orbital gyrus leads to marked cutaneous vasoconstriction and a reduced reaction to cold. Curiously, mechanical and electrical stimulation of this area or application of cold had the same effects as its removal (4). Thus might suggest an inhibitory function for the area. Are we to suppose that hypnotic suggestions of comfort are capable of so modifying integrative appreciation of afferent inputs at the higher central nervous system levels? Further, is it possible that this modification is manifest in altered neural and neurohormonal outflow to peripheral target sites in the response pattern to cold? The data suggest the possibility of some such generalized mechanism. Decreased heart rate, elevated TNR, and diminished shivering are not completely independent variables but rather can be viewed as interdependent peripheral effects of autonomic nervous system alteration, most probably central in origin. The data also show that despite a fall in heat production (due partly at least to decreased shivering) and despite a loss of body heat (ΔQ) the temperature of the skin remained essentially the same as when normal thermoregulatory mechanisms were unaltered (nonhypnotized condition). This maintenance of skin temperature we can explain on no other basis than that of altered vasomotor activity. Despite the lack of any direct evidence we must infer increased blood flow and heat transport to the periphery, without regard to any alteration in chemical heat production. Such an increased flow can only be accounted for on the basis of increased vasoconstriction due to decreased sympathetic activity, there being no evidence for para-sympathetic control of this phenomenon.

While the data are such that the hypothesis of decreased sympathetic "gain" due to hypnotic influence cannot be directly demonstrated, parsimony dictates primary consideration of this hypothesis as accounting for all the observed changes while under hypnosis, including the behavioral (4, 21, 22, 32, 33).

In summary, the results of this study are preliminary and do not warrant the use of hypnosis in current operational problems of thermoregulation. Our hypo-
thesis that hypnosis can alter thermoregulatory response in an objectively quantifiable way has been supported. While the mechanisms are unclear, our data suggest that an instant habituation is produced, similar to the pharmaco medical effect of chlorpromazine; and, like chlorpromazine, many of the effects of this alteration can be accounted for by decreased sympathetic gain. While we may not have simulated Hardy's thermally insensitive man, we feel that the data presented here indicate not only an approach to such a condition but also an explanation for the anticipated results.

The authors gratefully acknowledge the professional services of Dr. Fredericka Freytag of Dayton, Ohio, pertaining to the trance induction training, monitoring, and clinical evaluation of subjects during the hypnosis experiments. We also express our gratitude to Dr. Loren D. Carlson, Chairman, Department of Psychology, University of Kentucky, Lexington, Ky., an Air Force consultant, for his review and suggestions.

REFERENCES


MODIFICATION OF THERMOREGULATORY RESPONSES TO COLD BY HYPNOSIS

Final report, September 1962 - April 1963

Kissen, Abbott T., PhD
Reifler, Clifford B., MD
Thaler, Victor H., Major, USAF

November 1964

The effects of hypnosis on thermoregulatory responses were studied in non-acclimatized acutely cold-exposed men. Forty exposures (4.5 - 5.0°C) were conducted in an environmental chamber under both hypnosis and nonhypnosis conditions. Five subjects, wearing 1 clo insulation, were cold exposed for 1 hr, four times for each condition, and each subject served as his own control. Variables monitored included mean skin and rectal temperatures, heart and shivering rates, basal skin resistance, and vigilance task performance. In hypnosis, shivering was suppressed, heart rate lowered, and vigilance task performance improved. Basal skin resistance differed in terms of pattern and level, being generally higher under hypnotic conditions. Rectal temperatures were lower despite maintaining skin temperature at the same level as during nonhypnosis conditions. These findings indicate that with the thermal stress imposed and levels of trance achieved, there is a general amelioration of the psychophysiological effects of the stress. The mechanism responsible for this form of "adaptation" remains speculative but is consistent with generalized suppression of sympathetic activity.
Thermoregulation
Cold exposure
Adaptation
Sympathetic nerve activity
Shivering
Basal skin resistance
Vigilance task performance

INSTRUCTIONS

1. ORIGINATING ACTIVITY: Enter the name and address of the contractor, subcontractor, grantee, Department of Defense activity or other organization (corporate author) issuing the report.

2a. REPORT SECURITY CLASSIFICATION: Enter the overall security classification of the report. Indicate whether "Restricted Data" is included. Marking it to be in accordance with appropriate security regulations.

2b. GROUP: Automatic downgrading is specified in DoD Directive 5200.10 and Armed Forces Industrial Manual. Enter the group number. Also, when applicable, show that optional markings have been used for Group 3 and Group 4 as authorized.

3. REPORT TITLE: Enter the complete report title in all capital letters. Titles in all cases should be unclassified. If a meaningful title cannot be selected without classification, show title classification in all capitals in parenthesis immediately following the title.

4. DESCRIPTIVE NOTES: If appropriate, enter the type of report, e.g., interim, progress, summary, annual, or final. Give the inclusive dates when a specific reporting period is covered.

5. AUTHOR(S): Enter the name(s) of author(s) as shown on or in the report. Enter last name, first name, middle initial. If military, show rank and branch of service. The name of the principal author is an absolute minimum requirement.

6. REPORT DATE: Enter the date of the report as day, month, year, or month, year. If more than one date appears on the report, use date of publication.

7a. TOTAL NUMBER OF PAGES: The total page count should follow normal pagination procedures, i.e., enter the number of pages containing information.

7b. NUMBER OF REFERENCES: Enter the total number of references cited in the report.

8a. CONTRACT OR GRANT NUMBER: If appropriate, enter the applicable number of the contract or grant under which the report was written.

8b, c, & d. PROJECT NUMBER: Enter the appropriate military department identification, such as project number, subproject number, system number, task number, etc.

9a. ORIGINATOR'S REPORT NUMBER(S): Enter the official report number by which the document will be identified and controlled by the originating activity. This number must be unique to this report.

9b. OTHER REPORT NUMBER(S): If the report has been assigned any other report numbers (either by the originator or by sponsor), also enter this number(s).

10. AVAILABILITY/LIMITATION NOTICES: Enter any limitations on further dissemination of the report, other than those imposed by security classification, using standard statements such as:

(1) "Qualified requesters may obtain copies of this report from DDC."

(2) "Foreign announcement and dissemination of this report by DDC is not authorized."

(3) "U. S. Government agencies may obtain copies of this report directly from DDC. Other qualified users shall request through other qualified users shall request through"

(4) "U. S. military agencies may obtain copies of this report directly from DDC. Other qualified users shall request through"

(5) "All distribution of this report is controlled. Qualified DDC users shall request through"

If the report has been furnished to the Office of Technical Services, Department of Commerce, for sale to the public, indicate this fact and enter the price, if known.

11. SUPPLEMENTARY NOTES: Use for additional explanatory notes.

12. SPONSORING MILITARY ACTIVITY: Enter the name of the departmental project office or laboratory sponsoring (paying for) the research and development. Include address.

13. ABSTRACT: Enter an abstract giving a brief and factual summary of the document indicative of the report, even though it may also appear elsewhere in the body of the technical report. If additional space is required, a continuation sheet shall be attached.

It is highly desirable that the abstract of classified reports be unclassified. Each paragraph of the abstract shall and with an indication of the military security classification of the information in the paragraph, represented as (TS), (S), (C), or (U).

There is no limitation on the length of the abstract. However, the suggested length is from 150 to 225 words.

14. KEY WORDS: Key words are technically meaningful terms or short phrases that characterize a report and may be used as index entries for cataloging the report. Key words must be selected so that no security classification is required. Identifiers, such as equipment model designation, trade name, military project code name, geographic location, may be used as key words but will be followed by an indication of technical context. The assignment of links, rules, and weights is optional.