ISSN: 0975-833X

Available online at http://www.journalcra.com

International Journal of Current Research
Vol. 8, Issue, 04, pp. 29652-29655, April, 2016

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

RESEARCH ARTICLE

PSYCHOMOTOR PERFORMANCE IN INDIAN ANTARCTIC EXPEDITION

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ARTICLE INFO

Article History:
Received 18th January, 2016
Received in revised form
19th February, 2016
Accepted 25th March, 2016
Published online 26th April, 2016

Key words:

Psychomotor,
Antarctica,
Performance,
Dexterity.

ABSTRACT

The purpose of the study was to determine the impact of austere winter on psychomotor performance of expedition members who stayed for prolonged duration in Antarctica. Twenty-four volunteers (scientific and technical support personnel) from winter-over team of Indian Antarctic Expedition served as participants. The performance on psychomotor tasks namely hand steadiness, two-hand coordination, and finger dexterity were evaluated at pre and post winter session in Antarctica. A mixed group factorial ANOVA revealed that there was a significant decrease in error for hand steadiness and two-hand coordination, and decline in time (seconds) for finger dexterity at post-winter session when performance was compared against pre-winter session. However, no significant difference was found between scientific and technical support personnel in performance on psychomotor tasks.

Citation: Dr. John Paul, F.U. and Dr. Ramachandran, K. 2016. "Psychomotor performance in indian antarctic expedition", *International Journal of Current Research*, 8, (04), 29652-29655.

INTRODUCTION

Antarctic environment is described as extreme because survival is impossible for there is minimal vegetation or animal matter for food and the harsh climatic condition makes Antarctica inhospitable to human living. The most adverse aspect of the Antarctic environment is its exceptionally low temperatures which, even during the austral summer are normally below 0°C and can often drop below -40°C (Halsey & Stroud, 2012). The hostile weather conditions have adverse effects on the performance of temporary residents in Antarctica. Although advanced technologies, in particular in terms of clothing, sledges, and fuel storage has considerably reduced the hardships, the extreme physical environment continues to present several physiological and psychological stresses in Antarctic expedition members. The human performance gains a greater significance in the context of incredible demands of the physical environment of Antarctica. Cold exposures result in various adverse consequences on human performance. Further, the necessity of wearing highly insulated clothing to protect against extreme cold is another factor affecting human performance.

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The unpleasant sensations and thermal discomfort in cold temperature may be a distraction factor reducing the performance on tasks requiring cognitive abilities and motor skills, and it may also increase the risk of injuries while performing the task. Cold temperatures were observed to impair cognitive and psychomotor performance such as reasoning and learning (Pilcher, Nadler, & Busch, 2002), and dexterity (Thompson and Hayward, 1996). A number of studies have been conducted on motor function in extreme cold environment. Many investigators recorded poorer manual performance and lower dexterity in cold and extreme environments (for example, Bensel & Lockhart, 1974; Clark, 1961). In the cold, impairments in finger dexterity and muscle strength result in performance degradation, particularly in carrying out fine motor tasks (Phetteplance, 2000). Gaydos and Dusek (1958) found that performance deteriorate when finger skin temperature dropped. Loss of dexterity in the cold is also accompanied by reduction of tactile sensitivity, resulting in diminished feedback as to what the hands are doing. Gaydos and Dusek (1958) concluded that hand temperature is a vital factor in fine manipulation, but the body can be cooled to a distinctly uncomfortable level without affecting manual performance if the surface temperature of the hands is maintained at normal levels. In line with this study, Lockhart (1966) suggested that cooling the body while maintaining normal hand skin temperature does not affect performance of tasks involving only wrist-finger speed and dexterity. On the contrary, LeBlanc (1955) observed large decrement in finger dexterity in cold even when the hands are kept warm. Similarly, Lockhart (1968) stated that decrement in psychomotor performance resulting from cold exposure cannot always be alleviated by maintaining normal hand skin temperature. Antarctic temperatures result in greater fatigue (Patton & Vogel, 1984; Thompson & Hayward, 1996) and a reduced maximal power output (Nimmo, 2004; Oksa *et al.*, 2002). Teichner and Kobrick (1955) observed that visual-motor performance was markedly and immediately impaired in the cold and recovered gradually, but to a lower limit than it attains under optimal temperature conditions. It was also stated that the impairment of visual-motor performance in low temperature was the result of a lowering of the final limit of performance rather than a reduction of the rate or limit of learning.

It is obvious from the widespread of studies that cold exposures have a considerable influence on human performance. Extensive studies on manual dexterity and motor skills in extreme cold environment reported deterioration. However, the findings are incongruent as some suggested stable performance while others recorded impairment when hand skin temperature is normal. It is also evident that there is a fewer studies relating to performance on psychomotor tasks during the prolonged residence in Antarctica. Hence, a special interest was taken to determine the effects of prolonged exposure to cold and extreme environment on psychomotor performance of members in Indian Antarctic Expedition. As several studies (Clark, 1961; Lockhart, 1966 & 1968; Le Blanc, 1955; Bensel & Lockhart, 1974) reported poorer manual performance in cold and extreme environment, it was hypothesized that psychomotor performance will show significant deterioration at post winter session during prolonged residence in Antarctica.

In general, the crew members in most of the expedition to Antarctica consisted of scientists and military or support personnel. The personnel with professional background (scientists) were generally involved in less motor tasks and their activities were restricted to indoors. On the other hand, technical support personnel (maintenance staffs) were required to perform greater physical and motor skills at outdoor for longer duration in the harsh physical environment of Antarctica. Though investigators have studied about performance in motor skills, there is absence of studies relating to performance of different groups in the Antarctic expedition team. Therefore, this study examined the difference in performance on psychomotor tasks between scientific and technical support personnel as it may have useful implications for understanding performance of different personnel in Antarctic expedition.

Methods

Participants

Twenty four men (scientific and technical support personnel) who stayed for fourteen months at the Indian Research Base in Antarctica (70°45′S, 11°44′E) volunteered to participate in this study. The mean age of participants was 39.13 yrs (SD = 9.35 yrs). Among twenty-four participants, six men had already served in Antarctica for about fourteen months in different expedition team. For the remaining members it was the first winter-over experience in Antarctica. Twelve volunteers had professional background and the remaining volunteers were technical support personnel. Each subject was medically and psychologically screened and qualified for winter-over duty. The screening and selection were done by the National Centre for Antarctic and Ocean Research, Government of India. Informed consent was obtained from each participant after the study objectives and data collection procedures had been thoroughly explained.

Apparatuses

This section covers a brief description of the psychological test apparatuses, and also the method of administration as directed in the manuals. The tests used in the present study were broadly used psychomotor tasks that measure ability to handle motor skills and agility.

- Two-hand coordination. This test measures the ability to operate motor activities. The apparatus consists of an aluminum plate upon which are secured a slightly elevated triangle and a corresponding quadrilateral, made of hard rubber. The strips forming these figures are of uniform breadth. Subject was given a stylus one for right hand and a similar one for left hand. Either stylus, upon coming in contact with the aluminum plate, registers a sound with an electric buzzer. The data (error count) was recorded in terms of the number of times the subject touched the side of the aluminum plate. At the start of the signal, subject began to trace the figures, both hands going counter clock-wise. The subject was instructed to start and to stop both hands simultaneously. The right hand should describe its figure, the quadrilateral, in four counts, while the left hand completes its round in three. Ten successive trials were given and no time restriction was followed for any of the trial. The total error was counted and recorded at the end of each trial.
- Hand Steadiness. This test measures the ability to operate various controls of sophisticated equipments. Subject was instructed to hold the stylus with his hand firmly and insert the styles slowly and steadily into the test hole with the biggest diameter. Subject asked to keep the styles for 30 seconds in each hole. Error was counted when the styles touched the side of the hole. In this way, the test required subject to insert the stylus one by one in all the nine holes. The holes of the test are arranged in order of difficulty, that is, the diameter of each hole decreases progressively. Totally three trails were given and the total error was counted and recorded for each trial.
- Finger Dexterity. The subject was seated comfortably at a table about 30 inches in height. The board was placed in front of the subject about a foot from the edge of the table. The tray was placed on the right side of the subject if he was right-handed. The board was placed at an angel of 90^0 from the subject's preferred working hand. The board had 100 holes that have room for 1 pin in each of them. At a time, the subject picked up 1 pin and filled in each of the holes as fast as he can.

Using the preferred hand, subject started in the farthest corner of the board and was working from left to right side if he was right handed and vice versa. There were extra pins in the tray so that if subject dropped one or two on the floor, he will still have enough pins left. A few demonstrative trials were shown to subject by the experimenter. Four trials were given to subject, motivating the subject to work even much faster at the end of each trial. The time taken in each trial was recorded and tabulated.

Procedure

The Indian Antarctic Expedition was comprised of fourteen months of extended residence in Antarctica. The psychomotor performance was measured in two sessions namely, pre-winter and post-winter session during the expedition in Antarctica. The lowest temperature recorded in winter at the Indian base was -38^0 C and the average temperature in winter was -24^0 C. The tests were taken at the convenient time and were individually administered under the room temperature ranging from $+15^0$ C to $+18^0$ C. The study used two-way mixed group factorial ANOVA. The within-subjects factor was pre-winter and post-winter sessions of the expedition. The between-subjects factor was scientific and technical support personnel. It was ensured that assumptions required to carry out a mixed ANOVA were met when analyzing data using SPSS statistics.

RESULTS

The data of twenty-four participants met the assumption of normality, except for task of two-hand coordination. The score of two participants for two-hand coordination task were excluded since they were falling as outliers and had an effect on the parameter estimate and its associated estimate of error. A mixed group factorial ANOVA was performed to examine if there was significant difference between pre and post winter session in performance of scientific and technical support personnel on psychomotor tasks namely hand steadiness, two-hand coordination, and finger dexterity.

Table 1. Descriptive statistics for hand steadiness, two-hand coordination, and finger dexterity at pre and post winter session

Psychomotor Tasks	N	Pre-winter session		Post-winter session	
		Mean	SD	Mean	SD
Hand steadiness	24	10.15	4.61	8.99	4.2
Two-hand coordination	22	0.85	0.72	0.32	0.40
Finger dexterity	24	178.96	16.33	174.81	16.35

There was a significant main effect of winter session for hand steadiness [$F(1, 22) = 5.49$, $MSE = 2.95$, $p < .05$, $r = .20$], two-hand coordination [$F(1, 19) = 10.57$, $MSE = .28$, $p < .01$, $r = .36$], and finger dexterity [$F(1, 22) = 4.26$, $MSE = 51.45$, $p = .05$, $r = .16$]. This effect indicates that there was a significant difference in psychomotor performance of participants over the winter season.

Examination of the means suggest that there was a significant decrease in the error count for hand steadiness and two-hand coordination at post-winter session when compared to performance at pre-winter session in Antarctica (Table 1). Similarly, the mean time (in seconds) for finger dexterity showed discernible decline at post-winter session. Hence, the hypothesis of this study was not confirmed. However, the main effect of type of personnel was not significant for hand steadiness, two-hand coordination, and finger dexterity. This indicates that there was no significant difference between scientific and technical support personnel in performance on hand steadiness, two-hand coordination, and finger dexterity. Likewise, there was no significant interaction effect (session X type of personnel) for hand steadiness, two-hand coordination, and finger dexterity. It reveals that there was no marked difference between pre and post winter session in scientific and technical support personnel.

DISCUSSION

This study attempted to examine the performance on psychomotor tasks namely hand steadiness, two-hand coordination, and finger dexterity in Antarctica. Findings indicated a positive effect in psychomotor performance of personnel who were residing for prolonged duration in Antarctica. The error count or time in seconds taken to perform psychomotor tasks had significantly declined at post-winter session for hand steadiness, two-hand coordination and finger dexterity. There are some studies that support the finding that psychomotor performance does not deteriorate in extreme and unusual environment (for example, Lockhart, 1966). Nevertheless, there are several studies reporting poorer manual performance in cold and extreme environment (Clark, 1961; Le Blanc, 1955; Bensel & Lockhart, 1974). Also, little study are available that have noted improvement, if any, on psychomotor performance.

It is possible that under the moderate cold exposure (as a result of sophisticated thermal clothing and well-equipped polar station), and with the limited amount of stimulus under sensory deprivation, arousal was increased to a level, which improved performance. For instance, a theory suggests that the general arousal level is increased by mild/moderate cold exposure, which initially leads to improved performance. Nevertheless, it is also stated that with continued, prolonged or more severe cooling arousal may increase to a level where performance is degraded (Provins *et al*., 1973; Ellis *et al*., 1985; Enander, 1987). As explained by Palinkas *et al*., (1995), another possible reason for this positive effect in psychomotor performance may be that polar environments are inherently less stressful than they are generally portrayed. It is possible that the effect of winter season was less since the winter-over personnel were acclimatized to Antarctic climatic conditions that they developed better physiological tolerance to environmental extremes through continued exposures. However, the improvement in performance on psychomotor tasks due to acclimatization has not been conclusively tested. Other possible causes that facilitated psychomotor performance may include sample characteristics, and rigorous medical and psychological screening that participant had gone through prior to the expedition.

It is possible that psychological screening of personnel at the onset of Antarctic expedition may have resulted in highly motivated and skilled participants who better adapt with the extreme environment. For instance, it is stated that certain psychosocial characteristics combined with characteristics specifically adaptive for living in the polar environment enabled individuals to cope with the isolated and confined environments (Palinkas *et al*., 1995). Though possible rationale for the significant reduction in error count on psychomotor tasks have been explained, the findings point up the need for better control of confounding factors associated with psychomotor performance. It is interesting to know that scientific and technical support personnel in the expedition team showed no significant difference in performance on psychomotor tasks. The possible explanation for lack of significant difference in performance of scientific and technical support group could be that the tasks employed in the study were simple and lacked greater motor skills such as in complex tasks. When evaluating the results of this study, the obvious limitations in study design must be kept in mind. It is important to consider here that tests were administered in a cozy environment that did not signify the atypical or extreme conditions as subjects were tested under temperature of +15 to +18 degree Celsius, with protective clothes. The other factors include environmental adaptation owing to prolonged duration and voluntary participation of highly motivated individuals. Although, the study provides interesting information regarding psychomotor performance of personnel in Antarctica expedition, the findings need further support as empirical studies on psychomotor performance in Antarctica are thinly available to substantiate.

REFERENCES

Bensel, C.K. and Lockhart, J.M. 1974. Cold induced vasodilation onset and manual performance in the cold. Ergonomics, 17, 717-730.

Clark, R.E. 1961. The limiting hand-skin temperature for unaffected manual performance in the cold. Journal of Applied Psychology, 45, 193-194.

Ellis, H.D., Wilcock, S.E. and Zaman, S.A. 1985. Cold and performance: the effects of information load, analgesics, and the rate of cooling. Aviation, Space, and Environmental Medicine, 56, 233-237.

Enander, A. 1987. Effects of moderate cold on performance of psychomotor and cognitive tasks. Ergonomics, 30(10), 1431-1445.

Gaydos, H.F. and Dusek, E.R. 1958. Effects of localized hand cooling versus total body cooling on manual performance. *Journal of Applied Physiology*, 12 (3), 377-380.

Halsey, L.G. and Stroud, M.A. 2012. 100 Years Since Scott Reached the Pole: A Century of Learning About the Physiological Demands of Antarctica. *Physiological Reviews*, 92, 521–536.

Jones, J.A., Barton, R.R., Kang, K. and Fishwick, P.A. (Eds)). (pp.1020-1024). Society for Computer Simulation International: San Diego, CA.

LeBlanc, J.S. 1955. Impairment of Manual Dexterity in the cold. *Journal of Applied Physiology*, 62-63.

Lockhart, J.M. 1966. Effects of body and hand cooling on complex manual performance. *Journal of Applied Psychology*, 50 (1), 57-59.

Lockhart, J.M. 1968. Extreme body cooling and psychomotor performance. Ergonomics, 11 (3), 249 – 260.

Nimmo, M. 2004. Exercise in the cold. *Journal of Sports Science*, 22, 898–916.

Oksa, J, Ducharme, M.B. and Rintamaki, H. 2002. Combined effect of repetitive work and cold on muscle function and fatigue. *Journal of Applied Physiology*, 92, 354–361.

Palinkas, L.A., Suedfeld, P. and Steel, G.D. 1995. Psychological functioning among members of a small polar expedition. Aviation, Space, and Environmental Medicine, 66 (10), 943-50.

Patton, J. and Vogel, J. 1984. Effects of acute cold exposure on submaximal endurance performance. *Medicine Science Sports Exercise,* 16, 494–497.

Phetteplace, P. 2000. Integrating cold weather impacts on human performance into Army M&S applications. Proceedings of the 2000 Winter Simulation Conference.

Pilcher, J.J., Nadler, E. and Busch, C. 2002. Effects of hot and cold temperature exposure on performance: a meta-analytic review. *Ergonomics*, 45(10), 682-698.

Provins, K.A., Glencross, D.J. and Cooper, C.J. 1973. Thermal stress and arousal. *Ergonomics*, 16(5), 623-631.

Teichner, W.H. and Kobrick, J.L. 1955. Effects of prolonged exposure to low temperature on visual-motor performance. *Journal of Experimental Psychology*, 49 (2), 122-126.

Thompson, R.L. and Hayward, J.S. 1996. Wet-cold exposure and hypothermia: thermal and metabolic responses to prolonged exercise in rain. *Journal of Applied Physiology*, 81, 1128–1137.

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