

Abstract

As the widespread proliferation of touch technology creates new hopes in the world, tactile information is also becoming an integral part of modern military systems. But the author contemplates that the acceptance of any such new technologies would be dictated by the users, only as per the associated perceptual accuracies. Else the perceptual errors, if any, associated with such technology could be hazardous and expensive, for many experts in military. Thus, the author, being from military background, got inspired to cognise and report the association of high-altitude, fatigue, a psychobiological state of soldier in many situations, and the body reference frame used by soldier to handle critical situations during covert operations, with tactile sensation and perception, an integral part of human peripheral nervous system.

To fulfil the aim, three research objectives were deliberate. First objective was to understand the effect of hypobaric hypoxia on human tactile perception. Second objective was to convolute the effect of fatigue on tactile perception, while undertaking prolonged fine motor skill oriented repetitive military tasks and the third objective was to ascertain the accuracy levels of tactile perception by varying spatio-topic bimanual settings, under suppressed visual feedback, a situation similar to covert operation, where visual feedbacks are generally being suppressed. Three experiments were designed for the three respective objectives. The first experimentation involved 24 subjects, to review the two-point threshold (TPT) and tactile roughness discrimination threshold (TRDT), under HH conditions. In second experimentation, the concurrent quantification of subjective fatigue levels and tactile detection threshold was undertaken with the help of 50 subjects. The third experimentation convoluted 60 subject and evaluated different spatio-topic bi manual settings to understanding the role of reference frames, in detection & localization of touch, under suppressed visual conditions (subject blind folded).

The first experimentation, associated with objective 1, concluded that the acute induction of subjects to an altitude of 3500m probably may not affect the tactile perception and suggested that keeping perceptual conditions intact, more touch-based human-machine multimodal interfaces for military can be engaged in HA. The second experimentation, associated with objective 2, suggested reliable decreasing trend in tactile sensation($p=0.05$) and dexterity($p=.0001$), after experiencing higher fatigue levels during prolonged fine motor skill oriented repetitive tasks. The study reported that this drop in tactile acuity could probably affect the effectiveness and efficiency of concerned experts in war time/ operational scenarios. Thus, review and redesigning of probes/tools, being used by experts, to undertake high precision military tasks in such situations need further review. The third experimentation associated with spatio-topic bi manual settings and the reference frames used in different cortical regions to representing spatial locations of objects. Experimentation, under suppressed visual conditions (subject blind folded), showed significant reduction (14.6%) in accuracy levels of detection and localization of touch. Thus, highlighted greater role of hand/body reference frames in coding tactile stimulus under suppressed visual conditions. Thus, to increasing the operational perceptual efficiencies of soldiers during the night or covert operations, author would like to propose a close two-handed interactive design for the future soldier systems.

As the role of tomorrow's soldier would be dictated by a potentially difficult environment, there is a prerequisite for greater demands on soldier sensory systems. Thus, it is essential to review and enhance the soldier's tactile perceptual capacities in such difficult environment. The present research work is devoted to such endeavours. Though the research in this thesis has been conducted with military conditions in mind, the usage of findings of this thesis are not subjugated to the military environment and can be well applied to numerous other similar situations in civil arena.