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CISM Sport Science Abstract
Research line: Psychophysiological military fitness and operational readiness

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The Future of Wearable Monitoring for Military and Sports Performance Enhancement

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Introduction

Wearable monitoring technologies may be useful for military and sports performance enhancement. Monitoring training workload and thermal work strain can provide safer and more effective training of military recruits.[1,2] However, the role of physiological monitoring in performance enhancement of experienced performers remains an open question: does this provide advantage over expert self-awareness, and could it ever become so useful that it might be banned from competition as unfair "technological doping?"

Technology Development

Wearable physiological sensors can now provide an unprecedented amount of information about an individual in real time. This "technology push" has been stronger than the "athlete/performance pull," and many commercially available systems are in search of a problem to solve. For example, elite Kenyan runners routinely lose water (~3.0% body weight) during running, and this may provide an advantage in improved oxygen transport and reduced body mass.[3] However, sophisticated technologies based on sweat and skin hydration are marketed to "optimize water balance" without scientific validation against total body water and performance outcomes, or with demonstrated improvement over experienced athlete self-assessment, simple body weight change, or urine colour. Activity monitoring, estimated physical workload, and sleep can be useful data in individual training management; movement patterns in team sports have also been useful to coaches; future data on continuous biochemistry such as lactate, and information on brain and mood state may prove to be useful data to manage performance but, initially, only as research tools.[4] Wear-and-forget systems built into smart shoes and functional fabrics are being developed and will be commonly available in the near future.[5,6]

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Current Research and Applications

Real time physiological data has been used to optimize pacing. In one demonstration, an endurance cyclist competing in a 5000 km race planned rest periods around computed optimizations based on physiological fatigue factors and the conditions on the path ahead.[7] In another experiment, individuals were optimized by computer feedback based on their real time physiological status, with continuous advice on their pace in order to complete a distance within a set time while remaining as cool as possible.[8] In this example, novice runners were helped by computer pacing but an experienced triathlete was able to self-pace just as well as the computer; thus, athletes may not gain an additional benefit, unless confronted by new conditions for which they have are not prepared (e.g., work at altitude). Near-future technology may provide stress management feedback using a "physiologically aware virtual human" acting as a virtual coach to the soldier athlete, based on machine interpretation of neurophysiological and behavioral signals.[9] These may be obtained from monitoring movement patterns in smart shoes, eye movements, facial action units, voice stress, and even stress odors. In initial studies, young soldiers were more willing to interact and disclose personal issues with a virtual human.[9]

Practical implications

Wearable physiological monitoring is useful in recruit training. It may also provide value to experienced soldier athletes, with insights on performance, injury prevention, and stress management based on patterns of movement and physiological signals, but this has to be demonstrated.

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