Wearable technology for athletes: information overload and pseudoscience?

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In an effort to maintain a winning edge, monitoring health and training load has become a key focus for athletes, coaches and sports scientists. In this context, wearables are appealing because they are lightweight, can be worn close to and/or on the skin surface, and detect, analyze and transmit information about various internal and external variables (3). Wearables are currently a $6 billion dollar industry (3), and are projected to be a $25 billion industry as early as 2019 (8). Despite this popularity, very few wearable devices have been rigorously and independently tested to determine the accuracy, reliability and validity. The main limitations of current wearable devices center around the following factors (3): the need to place devices at specific anatomical locations; movement artefact; data sampling frequency; non-invasive measurements; monitoring of a few selected variables (as opposed to a suite of variables); lack of measurement of environmental factors (e.g., temperature, humidity, altitude, UV radiation); uncertainty about accuracy of data interpretation (by athletes/algorithm versus trained professional); inability to transmit data indoors, underwater and in built-up areas; and interference from other physiological responses (e.g., vasoconstriction, hypovolemia). In addition to these technical issues, the development and marketing of wearable technology is associated with various ethical considerations relating to consumer awareness.

Increasing recognition of the importance of sleep for athletes has stimulated a proliferation of devices to measure sleep duration and/or quality. Most of these are in the form of wrist-watch type devices that use accelerometry to detect movement. Other devices are designed to be placed on the athlete’s bed, and again use accelerometry to detect movement. Very few of these devices have been compared with the gold standard of polysomnography, and the manufacturers often do not share the algorithms used to detect sleep and wake. Sleep monitoring is a good example of scientists and support staff embracing a
popular sport science trend, with many using monitoring devices that have not been validated. Careful consideration of how data collected from sleep monitoring is presented to athletes is necessary. Given the relationship between stress/anxiety and sleep, athletes may become overburdened if they have issues with their sleep, especially around competition. Further, whether it is necessary for athletes to have information about their sleep readily available each night is questionable. Having unreasonable expectations about sleep (i.e., that we should sleep perfectly each night) can contribute to issues around sleep for athletes.

The wearable market has influenced opportunities to collect an almost endless amount of data which has opened up opportunities in medicine, occupational health, and sport. However, with the flood of data collection opportunities there also are downsides (10). As scientists we must be vigilant with regards to measurement and the concepts of reliability and validity (1, 4, 7). Furthermore, careful attention should be given to whether these devices provide accuracy and precision when deployed. Considering the importance of protecting and developing health and talent, what and how variables are measured greatly matters (2, 4). Many who have entered the space of sport/fitness technology have not taken the appropriate steps to validate their measurement processes, yet they have perfected their marketing.

Once sport becomes competition, it is arguably no longer sport. This ideology could explain why individuals look for shortcuts in sport—and possibly within the sport technology industry as well. An example is the recent introduction of transcranial direct current stimulation devices (tDCS) in sport technology. Companies making such technology make strong claims of performance and health benefits, but the research remains mixed, and clarity is needed for safety and positive impact (5). Some companies have applied their own normative value of acceptability whilst looking for an edge. This often means that critiquing and questioning of science is minimal (or non-existent) for the sake of market presence and sales.

A great cause for concern is that the sport community (athletes, coaches, etc.) may be convinced by pseudoscience due to sport technology companies using neuroscience and social psychology in their marketing plans (6, 9). We live in a time where we are surrounded by both the pressure for our attention, and the excessive proliferation of information. Sport technology companies have used knowledge about our human attraction/attention tendencies to influence us through their presentations. They do this by ensuring that supportive works in marketing material closely resemble peer review articles, when these works are not in fact peer reviewed. It is unfortunate that we find ourselves in a place whereby individuals can convincingly assert ‘facts’ that sound truthful, but largely amount to pseudo-science (11). The
information overload we experience from sensationalized media, and the extent of unchecked information made available on the internet, are a couple of reasons that this confusion is possible.

When dealing with athletes, in particular elite athletes, appropriate evidence-based scientific principles should apply to the use of both wearable and performance-enhancing technology. The following are recommendations when considering using devices: 1) the primary driving principle should be to first do no harm, and direct implications on athlete health and safety should be of utmost and initial concern; 2) following such considerations, questions should be asked regarding the scientific basis for the device and a search for scientific evidence should occur; 3) if there is no or minimal scientific evidence, data should be collected in situ, in a controlled manner where possible; 4) implications for the athlete should always be considered (e.g., too much information, unnecessary information or information that may cause stress and anxiety). Although as scientists we may appreciate the collection of numbers and data, this must we be weighed against the potential negative influences on the athlete. If the use of GPS monitoring has taught us anything, it is that time, rigor and careful analysis is required before truly meaningful data is available for athletes and coaches.

References

5. Horvath JC, Carter O, Forte JD. Transcranial direct current stimulation: five important issues we aren’t discussing (but probably should be). *Front Syst Neurosci.* 2014;8:2.

