State-of-the-art backpacking

The effect of backpacking in the military and everyday life

BY DANIEL MCKILLOP

An ambitious study taking place in the Kinesiology Department of Dalhousie University could change the way people and the military view backpacking. The study is looking into the physiological effects of arduous backpack walking.

Using computer technology, Masters student Ryan Johnson is measuring the biomechanical changes of volunteer subjects during and after they march long distances wearing backpacks that weigh 25 kilograms.

Inspired by the set military protocol of properly packing a backpack, and the deviations Canadian troops often take from the established standard, Johnson's research project will explore the advantages and disadvantages of loading the pack one way over another. Although the actual military backpacks used by the Canadian Armed Forces could not be obtained, the research team is using a recreational version, which were specially manufactured for the university project by Ostrom Outdoors, an Ontraio based company.

In order to measure the effects of varying the weight distribution in the packs on the people carrying them, a 25 kilogram block of lead, along with styrofoam, is placed in the backpack. Participants must march 10 kilometers around Dalplex each time, while the placement of the lead block shifts from high inside the backpack, to the middle, and to the bottom. One trial is also reserved for attaching one half of the total weight (12.5 kilograms) to both the front and back of the subject, where a smaller pouch is strapped to the chest.

Interestingly, the project is being supported by Adidas. The company will benefit by having a particular brand of shoe tested for comfort and durability after heavy use, and may refine the sneaker as a result of Johnson's findings. A work order was sent to Adidas Asia and the shoes were sized for the participants of the project at Dalhousie. Adidas Canada donated brand-name t-shirts and waterbottles, and Adidas International provided the shoes.

Ten tiny and very expensive, reflective spheres are attached to the subject's body and backpack as he or she steps over a force plate. The plate is set on a platform that is in close range of five infra-red cameras, which reflect the IR light off of the moving spheres on the subject's body, then electronically compute the location of the markers in a threedimensional space, producing an animated image of a body and backpack on a computer screen. The visual picture that is generated on the computer is an outline of the ten lodes secured on the subject, forming a recognizable shape. Three markers are placed on the backpack, three on the foot, one on the ankle, knee, hip and shoulder. At least two of the five cameras must see every marking sphere at al times in order for the data to be processed successfully into the computer and generated onto the screen. In order for the data to compute, the subject must walk across the platform at a constant speed, and fully step on the pressure plate. For reasons of accuracy, an average of the data collected at each trial over the plate is calculated by running five individual tests.

The total cost of the technical equipment used for the research amounts to roughly a quarter of a million dollars. While the motion capture equipment is being lent to the research team by the School of Physiotherapy, the computer that controls the system costs over $2,000 US, and the five infra-red cameras cost $17,700 each.

Before beginning the long walk, each subject must stand on the force plate without moving to establish a control reading of the subject's posture. The subject then passes over the force place five times while carrying the backpacks. After five kilometres, the subject is again read by the computer monitored camera, and returns to complete the final five kilometres to be read a third and final time.

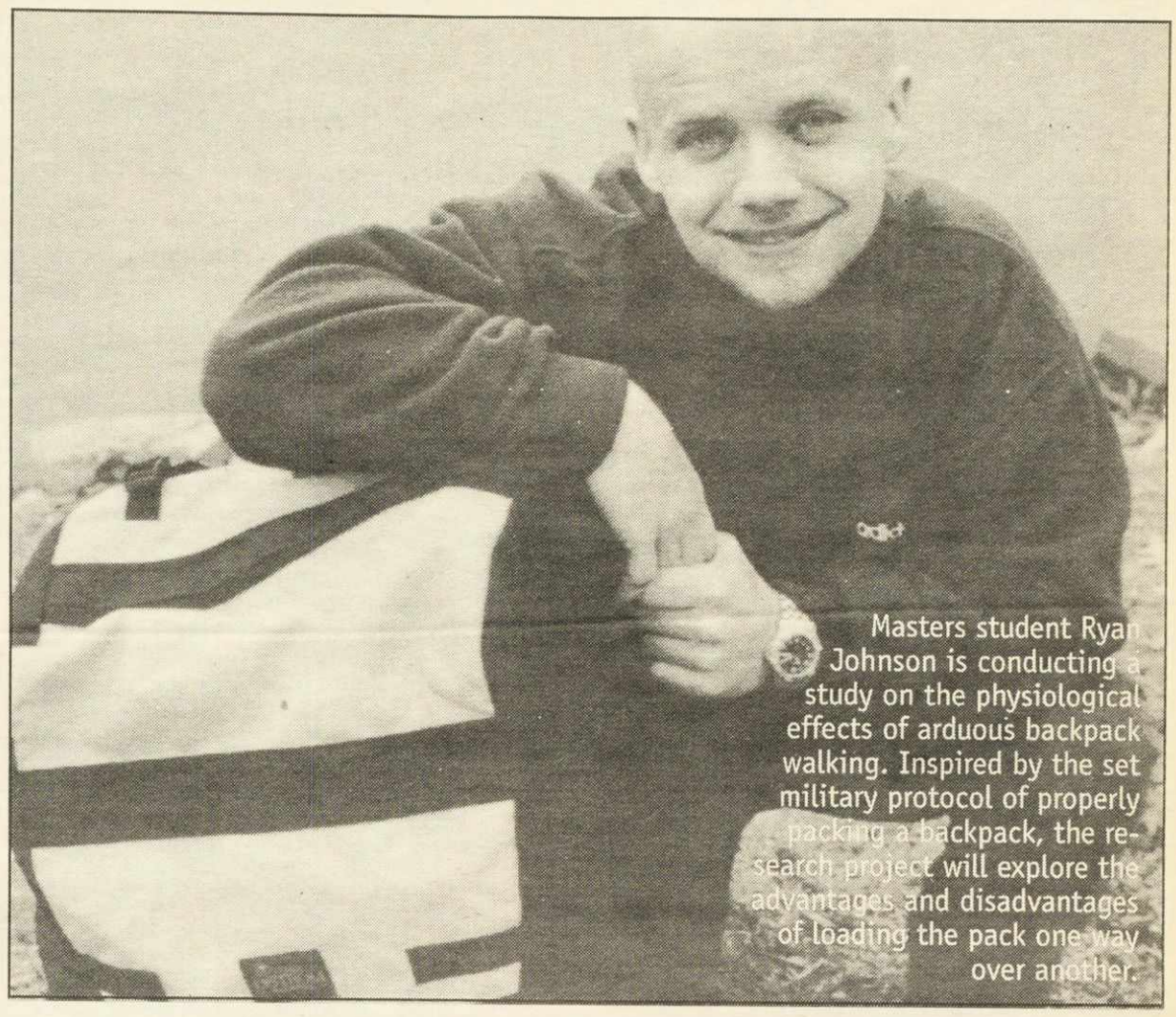
As part of the total ten kilometres, however, each subject walks a kilometre on a treadmill before being examined by the computer. While on the treadmill, a head-piece is placed on the subject, which is attached with a tube to a stationary metabolic cart that is designed to measure oxygen consumption. The machine also collects other measurements of physiological effects, such as metabolic rate, volume of consumed oxygen per kilogram of body weight, the volume of carbon dioxide exhaled by the subject, and the kinds of metabolic fuels that are burned while on the treadmill.

At the end of every 10 kilometre trial, each subject fills out a questionaire that is designed to evaluate both the perceivable effects of the load distribution in the backpack, as well as the strengths and weaknesses of the Adidas shoes, relating to the arch support and heel hold, as well as other aspects.

The beginnings of the research began in last November, and is mostly privately funded by Johnson and his advisor, Dr. Ron Pelot, a professor of industrial engineering at Dalhousie.

Pelot described the project as "an ambitious and very useful study with a broad scope." Since, he said, "many manufacturers do not end up testing their products themselves," he knows the project, among many things, "will provide additional information to establishments like the military by explaining certain trade-offs and variables" if they had not already been tested for.

Included in the team are three undergraduate assistants, who are necessary and instrumental in seeing that the project completes itself. As well, there are ten people participating as subjects, each volunteering once a week for three hours. The subjects were recruited based on their levels of fitness, height and their availability during the five week testing period.



Masters student Ryan Johnson is conducting a study on the physiological effects of arduous backpack walking. Inspired by the set military protocol of properly packing a backpack, the research project will explore the advantages and disadvantages of loading the pack one way over another.

Participants are always supervised during the 10 kilometre trek around the Dalplex, and the "Dalplex staff has been absolutely fantastic, said Johnson.

During one of the tests, a volunteer was marching ten kilometers with an empty backpack, to establish a baseline scan for how he functions when not loaded down with 25 kilograms. The actual experimentation stage should be completed by the end of November.

"The data will go to the pack manufacturer," said Johnson. "We'd love to see the papers published," which he believes is "the goal of every research project. It's good news for students in general," he maintains, "since you don't need to have a Ph.D for your work to matter."

"It is especially excellent that a company like Adidas accepts grad studies as valid."

Johnson hopes the whole project will be completed by May.