Walking efficiently takes next to no thought

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Whether walking beside a lake or clambering a mountain, people adjust their strides to use the least energy possible. "People are continuously sensing their energy expenditure and adapting their gait to minimize costs," says Jessica Selinger from Queen's University, Canada, adding, "We adapt all kinds of gait characteristics—the speed we move at, the

length and width of each step—to minimize the calories we are burning."

But it isn't clear how this happens. Do people continually monitor their movements and consciously adjust to ensure economical movement, or do they adapt automatically without realizing? And if it is a conscious process, how much brain power do people hold in reserve when multitasking? Rachel Blair (University of British Columbia, Canada), Max Donelan (Simon Fraser University, Canada) and Selinger decided to find out whether people consciously adjust their movements to conserve energy by trying to distract volunteers with a series of beeps while they were walking. The scientists realized that humans do not have to think in order to walk efficiently, they adapt automatically, and Selinger and colleagues publish this discovery in *Journal of Experimental Biology*.

"The experimental set-up was technical and had many components," says Blair, describing how the team started out by getting the volunteers to walk on a treadmill at a comfortable speed as they listened to a stream of beeping tones through headphones, having to press a button in the right hand when the beep was higher than the tone before—or in the left when the beep was lower—to distract them. Then, the team got them to try out different walking styles by moving in step with a metronome while walking at the same speed, setting a faster or slower stride rate, which was either less or more efficient than their normal walk.

Once the volunteers came to grips with walking in different ways, the researchers switched off the metronome, but activated the leg braces that their subjects had been wearing. "Many participants assumed that the exoskeleton [leg brace] device was designed to make walking easier," Selinger says. However, the scientists sometimes used the leg braces to make walking harder—in much the same way that walking upstairs takes more effort—forcing the volunteers to adapt how they walked to find a more efficient style. Finally, the scientists threw everything at the volunteers simultaneously—asking them to walk in different ways while

concentrating on recognizing whether the tone they were hearing was higher or lower than the previous one, while at the same time trying to find an efficient way of walking in the sometimes-tiring leg braces. "It was a challenge to get all these aspects working seamlessly and in sync with each other," recalls Blair.

But how efficient would the volunteers be when juggling so many factors? The team reasoned that if they were having to think to find the most efficient way of walking in the leg braces, then the distracting beeping sounds would throw them, and they would use more energy. However, if they were adjusting automatically, then they'd naturally adapt their energy efficiency, despite the beeping distraction.

After analyzing the volunteers' responses, Megan McAllister (Queen's University) determined that they were able to adjust their walking efficiency automatically, even when distracted by the beeping tones: "When people adapt to energy-optimal ways of walking, they do so without consciously having to think about it," she says. And this ability to adapt our movements without thinking allows us to focus on other tasks while we're walking.

More information: Megan J. McAllister et al, Energy optimization during walking involves implicit processing, *Journal of Experimental Biology* (2021). DOI: 10.1242/jeb.242655

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