The effect of walking speed on gait adaptability performance is currently unknown but is important because of the frequent differences in self-selected walking speeds between people without and people with a lower-limb amputation.1–3 Moreover, walking speed generally scales with the proximal-distal level of the amputation, with slower self-selected walking speeds in people with a transfemoral amputation than in those with a transtibial amputation.3,4

In a supplementary experiment, we examined the effect of walking speed on the gait adaptability performance of a control group of people who were able bodied. They were invited to perform conditions 1 and 2 from the main study twice: once at their self-selected comfortable treadmill walking speed and once at a speed that was slower than the comfortable speed. When people walk more slowly, step times typically increase. Consequently, more time will be available to adjust gait to the visual context projected on the treadmill. We, therefore, expected improved gait adaptability performance when participants walked at a speed that was slower than their self-selected comfortable speed.

**Method**

The order of the 2 speed conditions was counterbalanced over participants, such that 6 participants first performed conditions 1 and 2 at their self-selected speed and subsequently performed conditions 1 and 2 at a fixed speed of 2.1 km/h (and vice versa for the other 6 participants). The latter speed was estimated to correspond to the self-selected speed of a representative group of people with a lower-limb amputation (based on the studies of Hofstad et al.1 Houdijk et al.2 and Waters et al.3). Outcome measures for condition 1 (obstacle avoidance success rates) and condition 2 (stepping accuracy) were determined as described for the main study.

The effect of walking speed on obstacle avoidance success rates was statistically tested using separate Wilcoxon signed rank tests for anticipatory obstacle avoidance and reactive obstacle avoidance. The effect of walking speed on stepping accuracy was evaluated with a repeated-measures analysis of variance for speed (2 levels: self-selected and fixed) × pattern regularity (3 levels: 0%, 20%, and 30%) followed by *post hoc* paired-sample *t* tests in case of significant pattern regularity effects.

**Results**

The average self-selected comfortable treadmill walking speed was 3.8 km/h (range = 3.3–4.2 km/h) and, therefore, was always considerably faster than the fixed speed of 2.1 km/h.

**Effect of Treadmill Speed on Obstacle Avoidance Success Rates**

Anticipatory obstacle avoidance was not affected by walking speed (z=0.74, *P* = .46), evidently because of a ceiling effect, with nearly perfect success rates (99%) at both speeds. In contrast, reactive obstacle avoidance was significantly affected by walking speed (z=2.21, *P* = .027), with higher success rates at the slower, fixed speed (95%) than at the faster, self-selected speed (81%).

**Effect of Treadmill Speed on Stepping Accuracy**

Significant main effects were observed for speed (F_{1,11} = 19.0, *P* = .001) and pattern regularity (F_{2,22} = 18.9, *P* < .001). Stepping was more accurate at the slower, fixed speed than at the faster, self-selected speed (25 mm and 31 mm, respectively). Paired-sample *t* tests showed that stepping accuracy differed significantly at all 3 levels of pattern regularity (all *P* < .009), with superior performance for the 0% variation condition (23 mm), intermediate performance for the 20% variation condition (28 mm), and inferior performance for the 30% variation condition (32 mm).

(Continued)
Discussion
The supplementary experiment clearly showed that walking speed affected gait adaptability performance, with the expected superior performance at the slower, fixed walking speed. Specifically, reactive obstacle avoidance success rates improved by 15% and stepping accuracy improved by 6 mm. Anticipatory obstacle avoidance success rates were not significantly affected by walking speed; however, this finding was simply due to a ceiling effect, with most participants reaching 100% success rates at both the self-selected speed and the slower, fixed speed.

The implication of this finding is that walking speed effects may play a confounding role in evaluations of gait adaptability in various groups of people, who may walk at different self-selected speeds; this situation will favor the gait adaptability scores of the group with the slowest self-selected walking speed. Because slower self-selected walking speeds were expected for participants with a transfemoral amputation than for those with a transtibial amputation or those who were able bodied,3,4 group effects (or the absence thereof) on gait adaptability performance scores in the main study should be interpreted with reference to the relationship between gait adaptability performance and walking speed observed in the supplementary experiment.

References