EFFECTS OF OPTIC FLOW WHEN SPONTANEOULY ACCELERATING TOWARDS THE WALK-TO-RUN TRANSITION

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INTRODUCTION

Understanding the interplay between the use of exproprioceptive information, such as optic flow, and the body dynamics could help us to gain insights into the control mechanisms of gait, and more specific, of gait transitions. Therefore, the purpose of this study is to investigate the influence of optic flow on spontaneous overground walk-to-run transitions (WRT), during which subjects were asked to accelerate in their own preferred manner (De Smet et al., 2008). As subjects did not accelerate in a pre-determined way (like on treadmill), it was not only possible to investigate the influence of the optic flow on the WRT-speed, but also on the entire walking acceleration prior to reaching transition.

METHODS AND PROCEDURES

13 female subjects participated in the study. The experiment took place in a hallway (1.8 m wide, 28 m long and 2.25 high). Black and white stripes (20 cm) were rear-projected on the sidewalls of the hallway. Three visual conditions were tested. In the control condition, static stripes were presented. In the forward condition, the stripes moved in the same direction as the subject at +2 $m.s^{-1}$ (= slower optic flow). In the backward condition, the stripes moved in the opposite direction as the subjects at -2 $m.s^{-1}$ (= faster optic flow). Each subject performed 12 trials divided into four blocks of three trials.

Subjects were asked to start walking from a stand still position in a spontaneously accelerating way, until the moment it would be more comfortable for them to run. Subjects' speed was measured at 1000 Hz by Noptel® Distance Laser (CMP2-30). Footscan® insoles (500 Hz) were used to detect foot contacts.

Subjects' speed profile of accelerated walking contains the speed of all walking steps, from the first walking step until the last walking step before transition, plotted against normalized time. Through each speed profile, a best curve was fitted by 4^{th} degree polynomials. To gain insight into the underlying factors that determine the speed profile, a best fit through subjects' SF- and SL-profile was also calculated. A repeated-measures ANOVA compared the profiles at every 10% of the time to transition (TT), in order to reveal whether significant differences between the visual conditions existed.
The transition step (= step 0) was defined as the first step with a flight phase. The last walking step before transition was defined as step -1, while the first running step was defined as step +1.

RESULTS

No significant main effect for visual condition was obtained for the time to transition (TT) ($F = .861$, $p = .435$), nor for the steps to transition (ST) ($F = .820$, $p = .452$) (Table 1).

Table 1 Mean time to transition (TT) and steps to transition (ST)

	TT (s) mean ± sd	ST (n) mean ± sd
Backward	3.094 ± 0.913	6.8 ± 1.9
Control	3.226 ± 0.873	7.1 ± 1.9
Forward	3.113 ± 0.958	6.9 ± 2.0

Subjects' speed, SF- and SL- profiles prior to reaching WRT are shown in Fig. 1. No differences between the visual conditions were observed, nor for speed, nor for SF and SL.

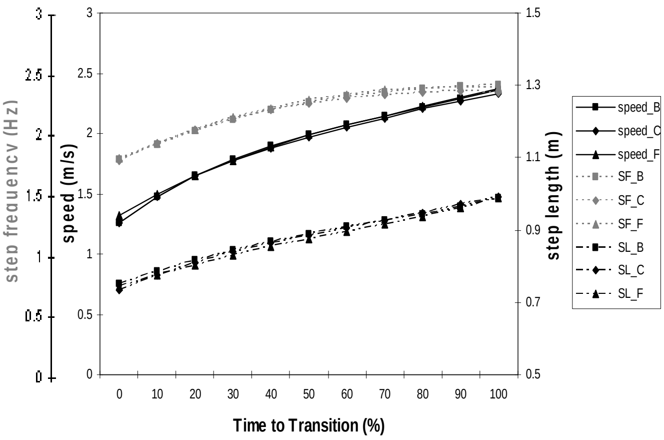

Fig. 1 Speed-, step frequency (SF)- and step length (SL)- profiles during the entire walking acceleration prior to reaching the WRT. Backward condition = B, control condition = C, Forward condition = F. No differences between visual conditions were observed.

For step 0, post-hoc pairwise comparison showed that speed and SL were lower in the backward condition than in the control condition. The same inter-conditional differences were observed for the speed and SL of step +1.

DISCUSSION

It is remarkable that the walking acceleration prior to reaching WRT was not influenced by a modified optic flow, whereas the average speed of step 0 was lower in the backward condition, caused by a smaller SL. This difference was also observed for step +1.

Three major discussion topics can be put forward:

1) the walking acceleration appears to be controlled by a control mechanism which is not online influenced by visual feedback.

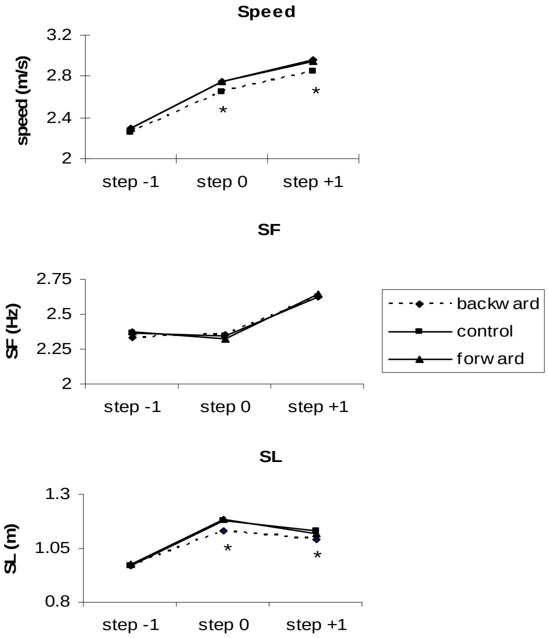

Fig. 2 Speed, step frequency (SF) and step length (SL) of step -1, step 0 and step +1. * significant difference between the backward and the control condition ($p < .05$).

2) backward flow induced a decrease in the WRT-speed. As such, subjects 'jumped' to a lower running speed after the WRT-step when experiencing a faster optic flow (= feed-forward). This was not observed when experiencing a slower optic flow.

3) starting from the WRT-step, the optic flow induced changes in the SL, which is in accordance with Prokop et al (1997).

SUMMARY

The modified optic flow influenced the WRT-step, but not the walking acceleration prior to reaching the WRT.

REFERENCES

De Smet et al. (2008). *Gait Post*, resubmitted

Prokop et al. (1997). *Exp Brain Res*, 28: 225-236.

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