IS THERE A GAIT TRANSITION BETWEEN RUN AND SPRINT?

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INTRODUCTION

The walk-to-run behavioral transition has been widely examined in the literature. It has been found that the preferred transition speed from walk to run is approximately 2.0 ms^{-1} [2]. However, the corresponding speed for the behavioral transition from run-to-sprint is unknown. Differences have been reported between run and sprint [3, 5], but it is not clear if run and sprint are two different modes of locomotion or if sprint is actually a fast run [1]. Hreljac et al. [1] found that joint kinetics increased from run-to-sprint over a continuum; without any significant change at some discrete speed. However, they suggested that an analysis of intralimb coordination, based on the principles of Dynamical Systems Theory (DST), might be more sensitive in distinguishing a specific behavioral transition point. In DST, the interacting components are examined while scaling up a control parameter that elicits a new pattern of coordination [4]. The purpose of this study was to examine the intralimb coordination strategies used during running at different speeds that range from a jog to a sprint. By using DST, we investigated the interacting segments, while scaling up the speed as a control parameter.

METHODS

Seven male subjects, all of whom exhibited a heel strike pattern at their preferred running speed, ran at their preferred speed (0%) and at 15%, 30%, 45%, 60%, 75%, and 90% greater than this speed, while sagittal plane kinematics were collected (240 Hz) from the right lower extremity. To examine segmental interactions, the phase portraits from segmental angular position and velocities were used to calculate phase angles [4]. Relative phase curves were calculated for two segmental relationships (foot-shank [F-S] and shank-thigh [S-T]) by subtracting the phase angle of the proximal segment from the distal. Mean relative phase (MRP) was calculated from the relative phase curves of each subject and for each condition. This was done by averaging the absolute values of all points of the curve for the braking and the propulsive periods of stance. A single factor repeated ANOVA was performed on the MRP group means for each segmental relationship and for each stance period. A Tukey test was performed in comparisons that resulted in a significant F-ratio ($p<0.05$).

RESULTS AND DISCUSSION

Statistical significance for both segmental relationships was found only during the braking period of the gait cycle but not for the propulsion period (Table 1). Both MRP F-S and S-T significantly decreased, indicating a more-in-phase relationship between the interacting segments as speed increased. Based on the post-hoc analysis, the 30% speed condition had the greatest effect. It is possible that this is the speed that the landing strategy changed from a heel-strike to a forefoot strike, and may indicate that there is a specific speed where the runner transitions from run to sprint.

Our results indicated that increasing the running speed from a run to a sprint elicited behavioral changes. These changes occurred during the braking period. The 30% above the running self-selected speed condition seems to be a critical speed for the observed changes.

REFERENCES

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Table 1: Group means and SDs for the parameters evaluated. Condition numbers underneath the means indicate post-hoc significance.

Variables (deg)	Running Speed						
	0%	15%	30%	45%	60%	75%	90%
MRP F-S Braking	80.7 ± 14.4 30% - 90%	64.1 ± 19.9 60% - 90%	53.8 ± 24.1 90%	44.7 ± 15.7	38.8 ± 24.9	37.3 ± 13.2	26.0 ± 9.4
MRP S-T Braking	68.0 ± 15.5 30% - 90%	53.2 ± 12.2 60% - 90%	45.3 ± 16.6 90%	42.2 ± 11.2	32.8 ± 19.7	35.3 ± 9.4	25.4 ± 7.4
MRP F-S Propuls.	53.8 ± 10.0	51.0 ± 4.1	53.0 ± 4.4	51.1 ± 10.6	50.7 ± 10.6	49.6 ± 4.2	46.4 ± 4.7
MRP S-T Propuls.	46.6 ± 7.2	44.4 ± 5.8	45.2 ± 5.8	43.9 ± 6.2	43.3 ± 8.4	43.3 ± 4.9	41.5 ± 4.2