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Avoiding Obstacles: Strategy Changes as a Result of Visual Field Limitation

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Unrestricted, the human visual field is approximately 200° wide and 135° tall (Werner 1991). As a consequence of certain hardware (e.g., head-mounted displays, night-vision goggles) and eye-disease (e.g., retinitis pigmentosa), this can be severely limited. Also, carrying large objects will cause partial occlusion of the lower visual field. Recently, the importance of peripheral visual cues in the online guidance of locomotion has been recognized (Marigold 2008).
Here, we present two experiments performed to investigate how visual field limitation influences obstacle avoidance behavior during human locomotion. Participants performed two separate obstacle avoidance tasks while wearing visual field restricting goggles. The first task involved stepping over a single obstacle situated in the pathway. For the second task participants were required to steer through a multiple obstacle environment. Using full-body motion capture we investigated the changes in motor behavior that occurred as a consequence of visual field limitation.
The results for both experiments show very similar behavioral changes: When we take the unrestricted condition as a baseline, it is observed that participants move at their desired speed over a path providing them with clearance to the obstacles that permits only small deviation from the planned path. It is proposed that this behavior is governed by an energy conservative strategy. Next, when the visual field is restricted to an intermediate size, we observed that participants enlarged their safety margin by taking a path that increased their clearance around the obstacles (both for stepping over, and circumvention). However, they did not slow down. Finally, when confronted with a small visual field, participants did slow down, in addition to further enlarging their obstacle clearance.
We conclude that for both obstacle avoidance tasks, participants choose to prioritize safety over energy conservation as a consequence of visual field limitation. Furthermore, it seems that only with a small visual field, safety concerns were substantial enough to warrant a decrease in speed.

References

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