ABSTRACT

Locomotion and posture are influenced and controlled by vestibular, visual and somatosensory information. Optic flow and scene polarity are two characteristics of a visual scene that have been identified as being critical in how they affect perceived body orientation and self-motion. The goal of this study was to determine the role of optic flow and visual scene polarity on adaptive modification in locomotor trajectory. Two computer-generated virtual reality scenes were shown to subjects during 20 minutes of treadmill walking. One scene was a highly polarized scene while the other was composed of objects displayed in a non-polarized fashion. Both virtual scenes depicted constant rate self-motion equivalent to walking counterclockwise around the perimeter of a room. Subjects performed Stepping Tests blindfolded before and after scene exposure to assess adaptive changes in locomotor trajectory. Subjects showed a significant difference in heading direction, between pre and post adaptation stepping tests, when exposed to either scene during treadmill walking. However, there was no significant difference in the subjects' heading direction between the two visual scene polarity conditions. Therefore, it was inferred from these data that optic flow has a greater role than visual polarity in influencing adaptive locomotor function.

1. Introduction

Locomotion and posture are influenced and controlled by vestibular, visual and somatosensory information [18,23,24,27,38,48]. Visual input information consists of various factors including variation in type and distribution of the content of the scene. Several characteristics of patterned visual scenes have been identified as being critical in how they affect perceived body orientation and self-motion [23]. These factors perceived from the visual scene are then integrated in the central nervous system and provide input for postural and locomotor control. Visual scene characteristics can be distinguished into two kinds of categories; those that contribute to optic flow and those that define polarity of the visual scene.

The role of optic flow in postural and locomotor control

Locomotion results from the output synergy of multiple sensory inputs, including vision. Visual inputs provide us with important cues for orientation and self-movement perception during locomotion. The patterned visual motion seen during self-movement constitutes the optic flow field that provides perceptual cues about self-movement and environmental structure [17].

Artificially imposed optic flow can cause changes in perceived body orientation and the sense of self movement (vection), when it conflicts with information from other sensory inputs. Studies have shown that subjects who are sitting and are stationary experience illusory self-tilt when viewing a real rotating circular display of dots [20,22]. Astronauts have reported increased sensations of body-tilt and self-rotation when viewing a rotating display of dots in microgravity. This is attributed to an increased reliance on