Gain-Matching and Perception of Self-Motion: The Relationship Between Optic Flow and Treadmill Walking

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Background

- Slow walking and generalised psychomotor slowing are frequent consequences of injury, illness, pain and ageing
- Treadmill training with fast walking speeds can improve walking outcomes
- Lack of motivation, pain and fear of falling can create challenges for treadmill-based therapy
Locomotor Rehabilitation

VR offers a wide range of rehabilitation options and novel environments.

- We need to understand our interactions with these environments to fully exploit their potential.

Striving for realism can reduce believability

Realistic: resembling or simulating real life; representing what is real (not abstract or ideal)

Believable: capable of being believed; can persuade to the truth or existence of
What is believable?

• Little available data on how movement is perceived in the virtual world relative to real-world motion

• Can we measure it?
  • quantifying what is not believable can help us to understand what is believable
  • Does walking affect the virtual world? Is this effect believable?

• Does it matter?
  • Deeper engagement with a virtual environment requires believability – immersion requires “willing suspension of disbelief” [2]

Aims of Current Work

• Investigate the ability to perceive changes in visual speed relative to walk speed and where the boundaries of “believable normal” lie.

• Create a treadmill-mediated interface which enables software gearing into the Virtual Environments
Recording Data:
- Every 1/10th second
  - Timestamp in ms
  - Distance walked
- After each participant speed judgement
  - Response
  - Current software gear

Method

Two conditions – each presented 40 discrete gear changes ranging from 0.1 (1m in real world drives 1/10m through VE) to 2 (1m in real world drives 2m through VE)

- Incremental – gear changes presented in step wise manner ascending then descending
- Random – 2 of each gear presented in randomised order

Participants walk on treadmill and give verbal judgement of environment speed - “slow”, “normal”, “fast”
Single subject results

Preliminary Results – 3 participants

- Perceived normal is not necessarily a 1:1 gear ratio nor any single gear but includes a range of gears
- Within subjects some variation in response, but a similar pattern of “ranges of gears” in each response across the conditions
- Participants often accepted a range of faster gears as normal
- More often correct in the perception of the slower gears
- Responses often ambiguous at the boundaries between perceived slow/normal and perceived normal/fast.
Implications

- For ‘immersion’ the environment must be believable, including gearing at a speed which appears matched even if it is not

- Judicious use of gearing may affect motivation, enabling more or less progress to be perceived depending on rehabilitation goals

- Benefits of altering optic flow can be harnessed to enhance rehabilitation [3]

Summary

- Virtual Environments need to be developed for locomotor rehabilitation studies

- ‘Correctly’ calibrated Virtual Environment may not be perceived as matched, decreasing immersion

- Use of software gearing will enable manipulation of environment to enhance rehabilitation
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References: