

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^[1]

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

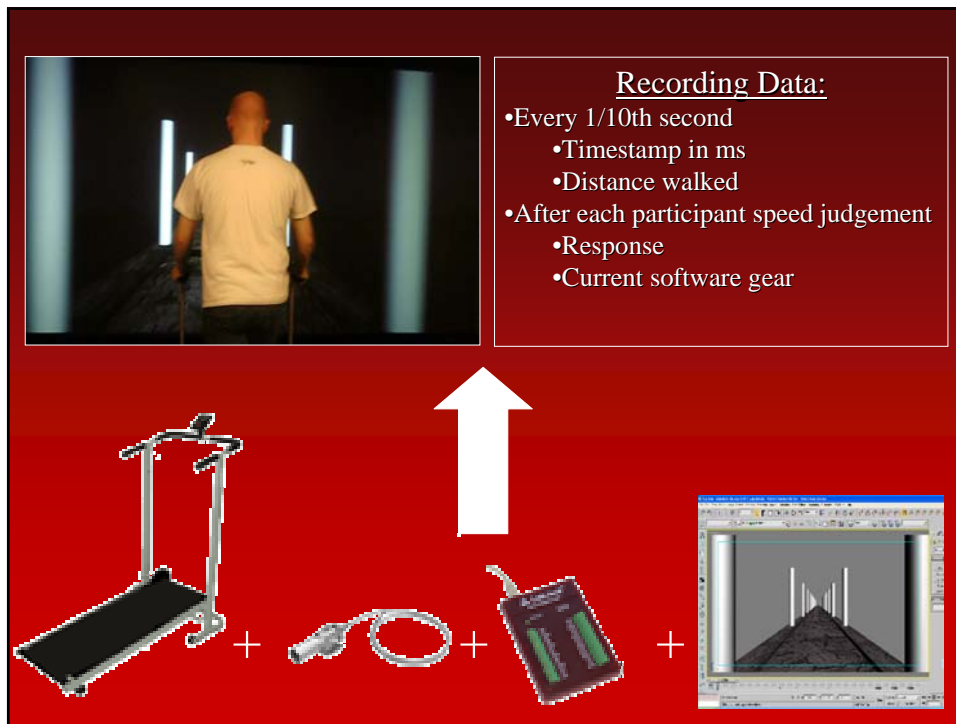
Believable: capable of being believed; can persuade to the truth or existence of

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



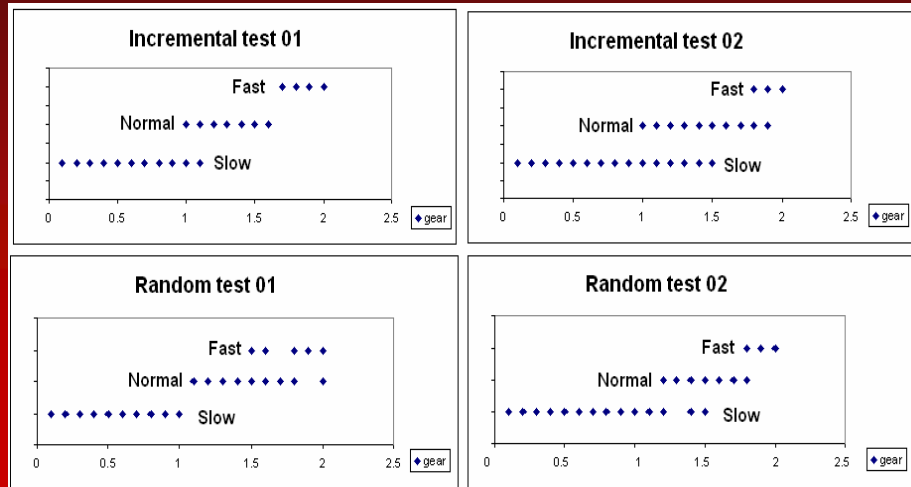
Method

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

Contact Details



- Any questions or further information:
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References:

[1] Brenton, H.: The Uncanny Valley: does it exist and is it related to presence? Presence Connect (www.presence-connect.com). (2005)

[2] Coleridge, Samuel Taylor. *Biographia Literaria*. 2 vols. Ed. J. Shawcross. Oxford: Clarendon Press, 1907.

[3] Powell, W., Hand, S., Stevens, B., & Simmonds, M. J. (2006). Optic Flow with a Stereoscopic Display: Sustained Influence on Speed of Locomotion. *Annual Review of CyberTherapy and Telemedicine*, 4, 65-70.