Haptic and locomotion Interfaces

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Premise of this talk:

To design better
human-computer/machine interaction

we need to understand
natural human-environment interaction

Objects are the **functional units** (or, currency) of the mind

Our mind **parses the environment into objects**

Question 1

What are the senses that we have?

Vision

Hearing

Smell

Taste

Touch (Haptics)

Proprioception
The sense of the relative position of one's own parts of the body and strength of effort being employed in movement

Vestibular sense
The sensory system that provides the leading contribution to the sense of balance and spatial orientation for the purpose of coordinating movement with balance

Interoception
The sense of the internal state of the body

Question 2

Rank the following senses according to their importance

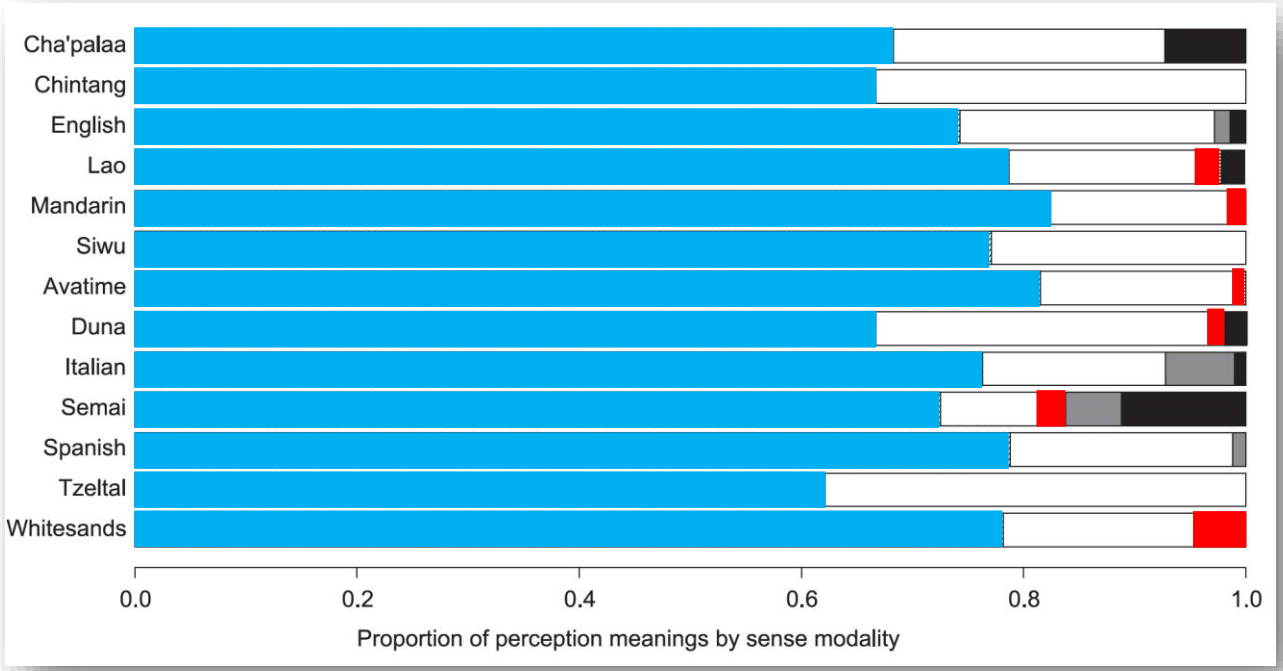
- olfaction (smell)
- gustation (taste)
- audition (hearing)
- vision (seeing)
- haptics (touch)

Question 2

ocularcentrism

Linguistic analyses across many languages show that **references to sight predominate** in spoken interaction

San Roque et al. (2015). Cognitive Linguistics, 26(1), 31-60.



- **Sight**
- Hearing
- **Touch**
- Taste
- Smell
- Multisense

*"Now **see** Mom, it's like this – When you're my age, you need a lot of extra money"*

Question 3

What do you call someone who cannot feel touch?

Anaphia: a total or partial absence of the sense of touch

Dysesthesia: an unpleasant, abnormal sense of touch

- Incapacitated with pain, despite no apparent damage to the skin or other tissue.
- Patients suffering from dysesthesia also often suffer from psychological disorders

Of the senses, some consider the principal is touch. Each sense has its own element: sight, water; hearing, air; smell, fire; taste, earth.

[…] I will say (following common opinion) that touch corresponds to the dregs of the earth; [but] in its praise, that we believe that **this [sense] alone is necessarily given for life**.

We see that the other senses are given us by nature **to ornament our existence**.

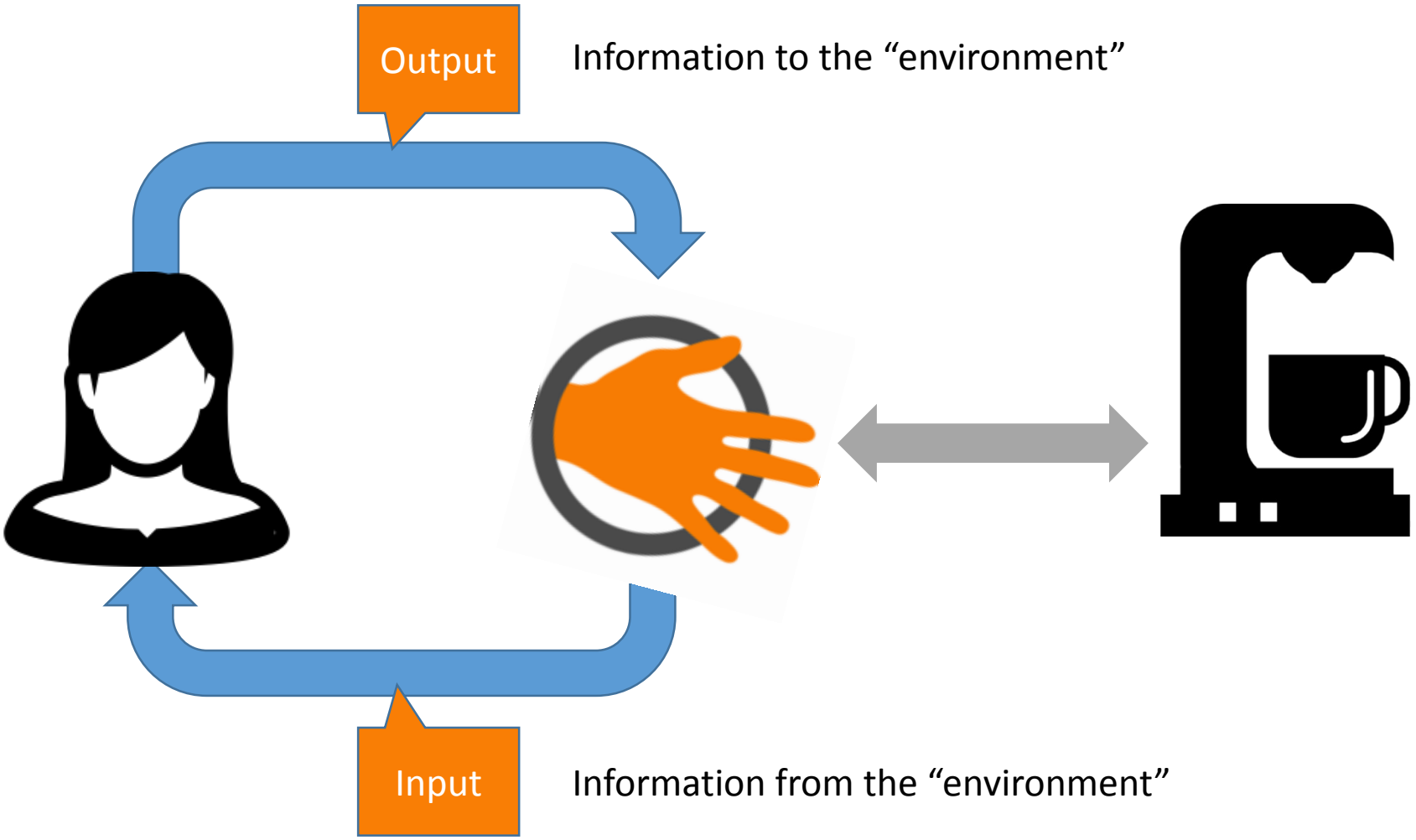
Equicola [1525]

Moulton, I. F. (2010). In praise of touch: Mario Equicola and the nature of love. *The Senses and Society, 5(1), 119-130.*

Active touch = **Haptics**

Haptics = “Passive” touch + Proprioception + Motor Commands

Input = Haptics = output

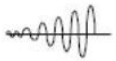
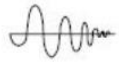


Haptics for input

Information display

- **Haptic icons**
- Notification
- Augmentation of GUIs
- Expressive control
- Communication of affect
- Mobile and handheld computing
- Guidance

Hapticons are small programmed force patterns that can be used to communicate a basic notion in a similar manner as ordinary icons are used in graphical user interfaces

Icon	Emoticon	Meaning	Hapticon
	:)	regular smile	
	:D	big smile	
	:(	sad face	
	;-)	wink	
	(k)	kiss	
	:$	embarassed	

Some emoticons and proposed hapticons by Rovers and van Essen [2004].

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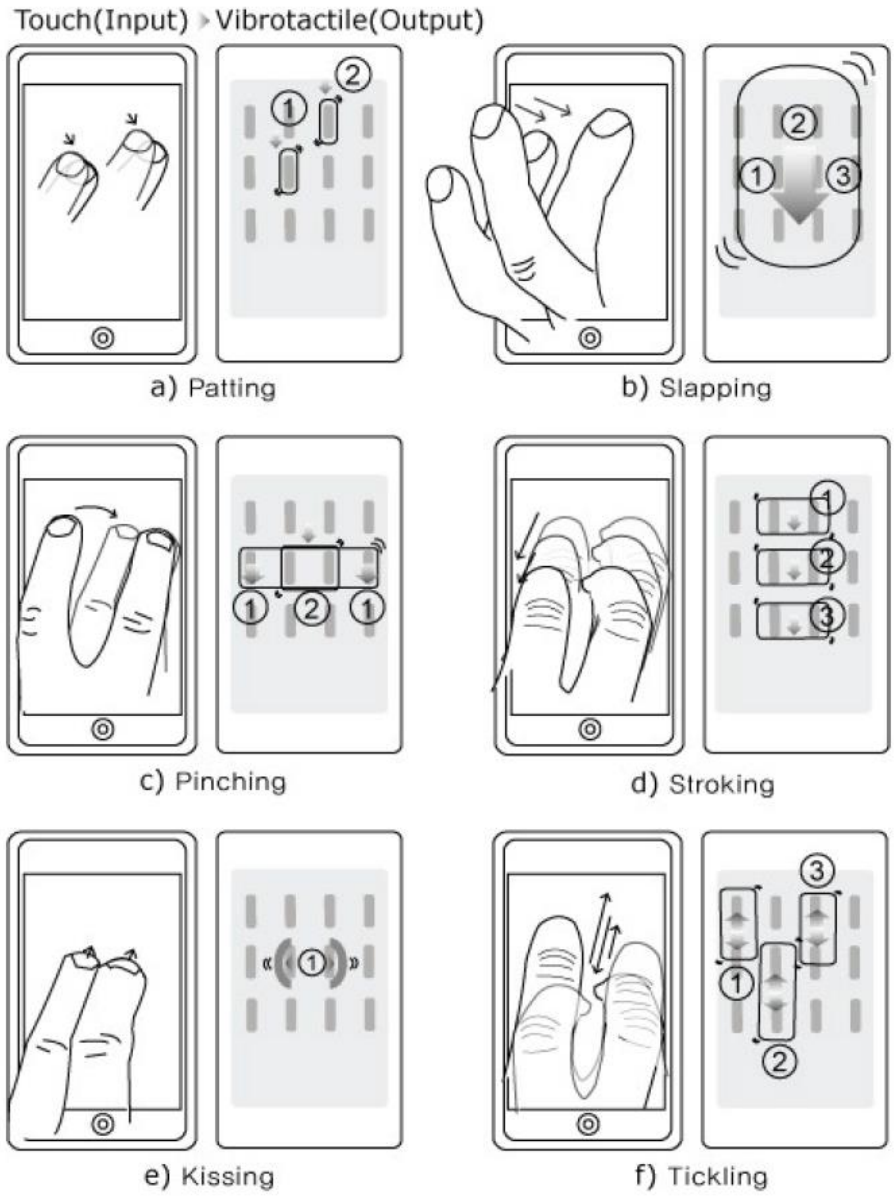

Young-Woo Park, Chang-Young Lim, and Tek-Jin Nam. 2010. **CheekTouch**: an affective interaction technique while speaking on the mobile phone. In CHI '10 Extended Abstracts on Human Factors in Computing Systems (CHI EA '10). ACM, New York, NY, USA, 3241-3246.

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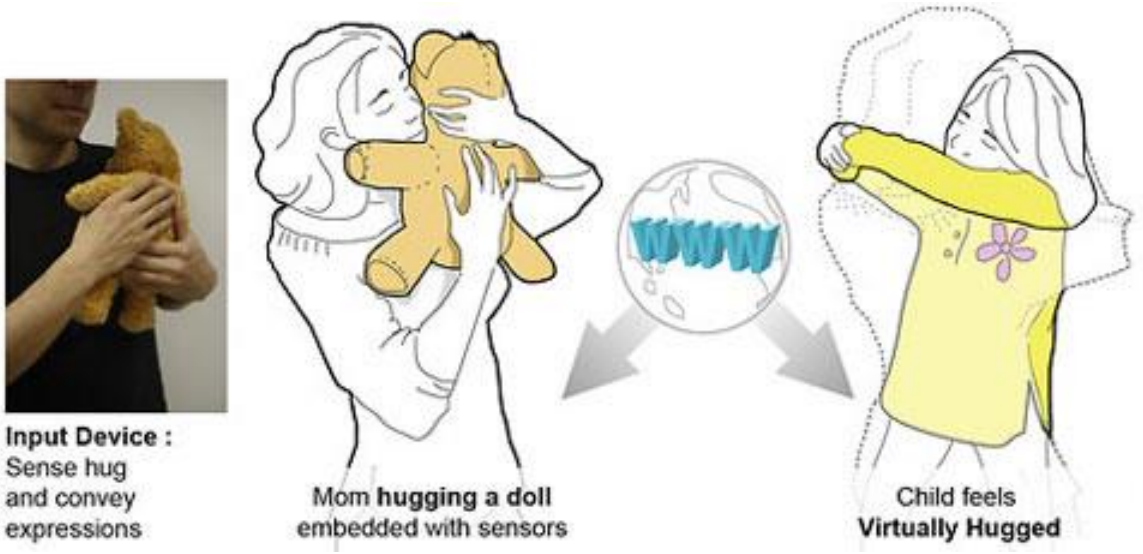

http://www.talk2myshirt.com/blog/archives/3971

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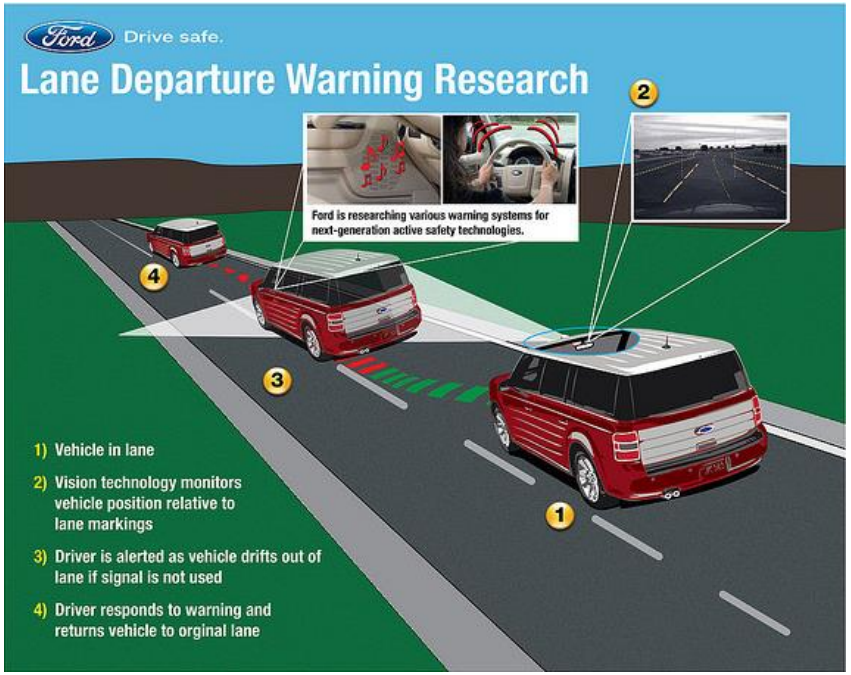

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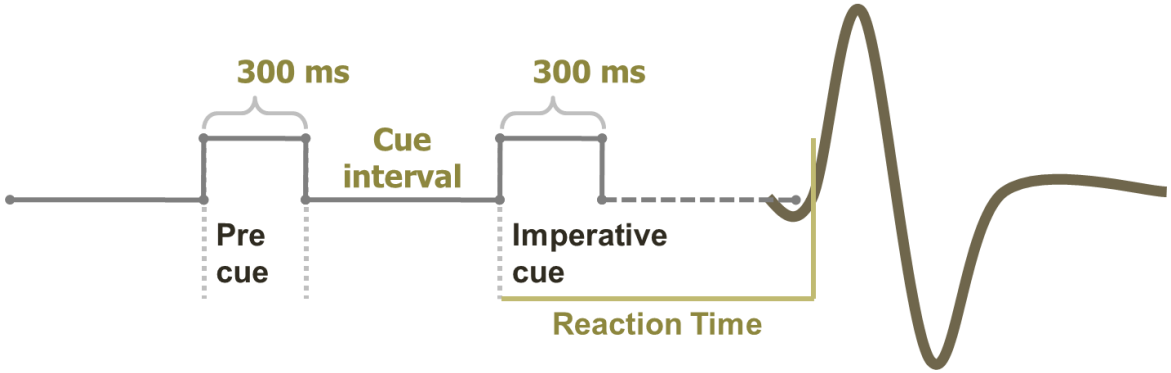

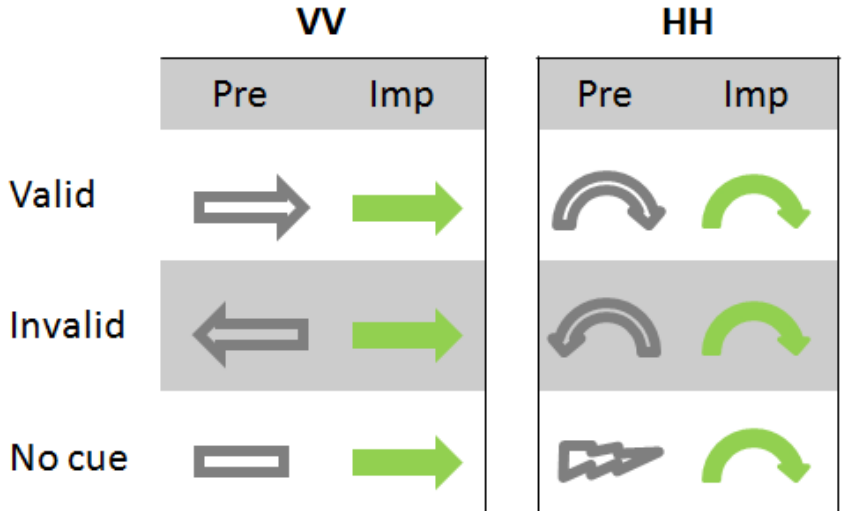

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Fixed-base driving simulator

- Full instrumentation
- Monitors: 115° x 25°
- SCANeR™ Studio (OKTAL)
- Active steering system for **realistic force feedback**

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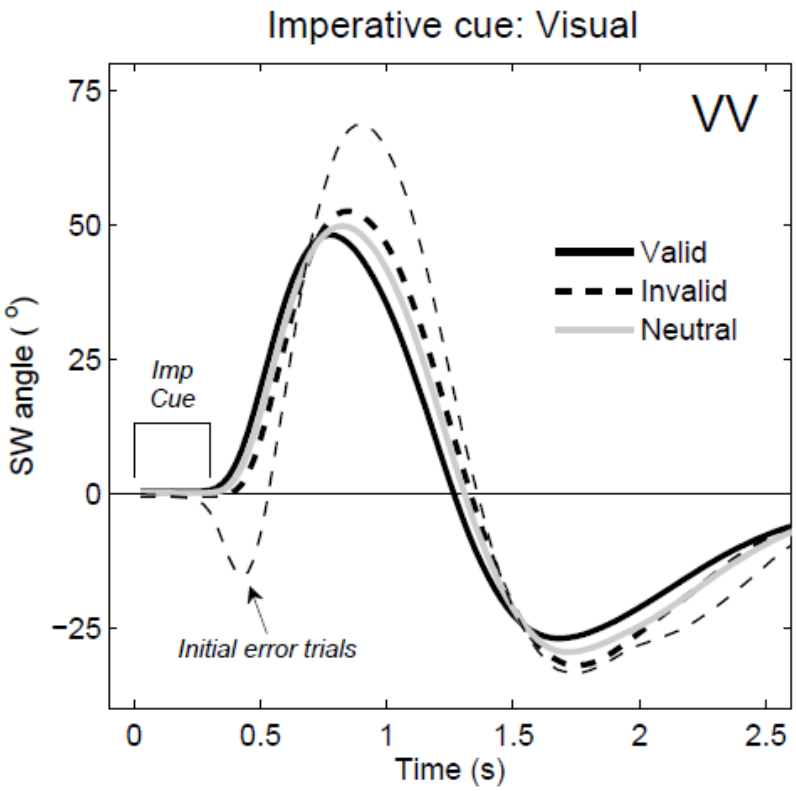

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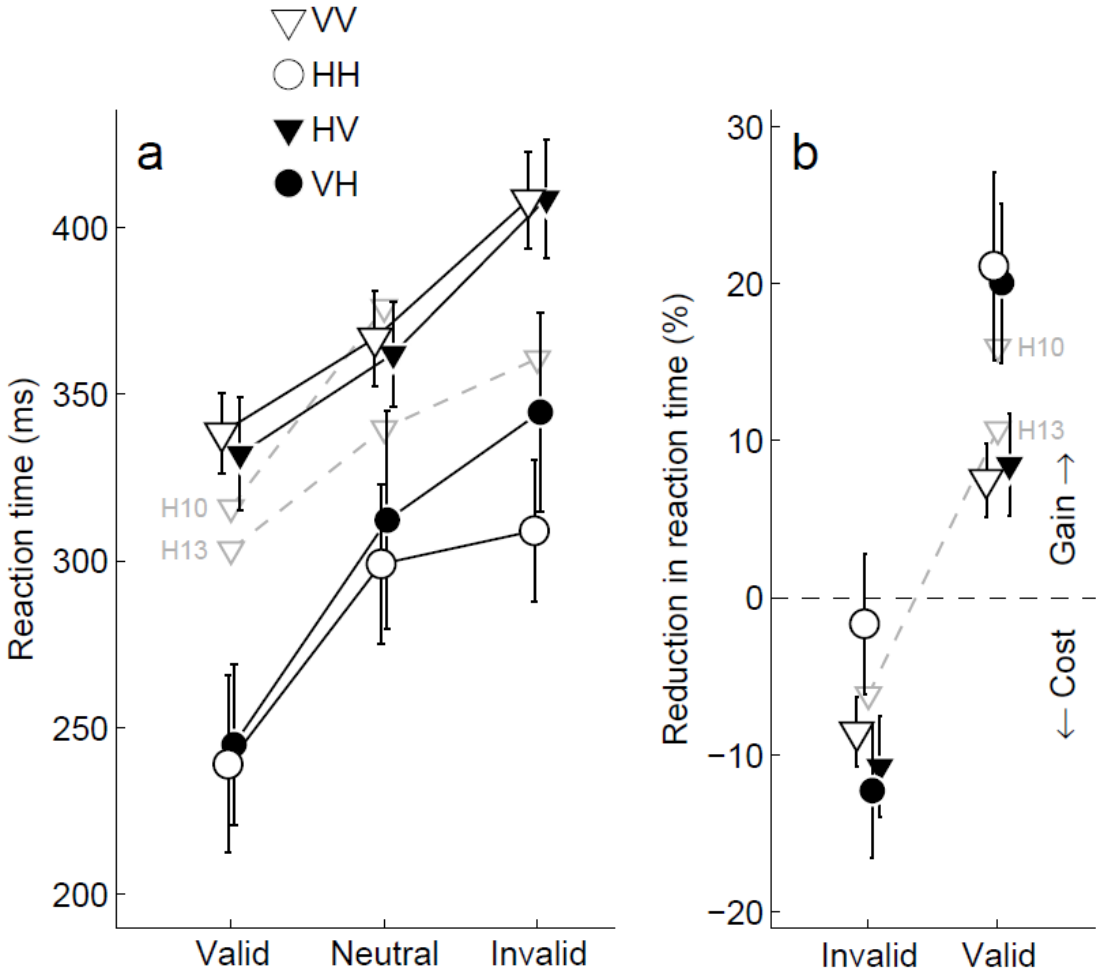


Haptics for output

Natural interface?

Virtual Reality

We now have near-photo realistic visual VR

http://www.igta5.com/screencaps

Immersive display

More ocularcentrism?

And we have hi-fidelity visual VR display options

Natural interface?

But we don't have natural ways to interact with (visual) VR

Locomotion interfaces

A treadmill is a solution; it allows user to cover great distances in a confined space. But movement is constrained to one direction/dimension

Natural unconstrained walking means going in any direction we please

Question 4 & 5

Design an interface that allows you to walk freely and naturally in all directions

Is the interface you designed…

- feasible?
- practical?
- affordable?

Locomotion interfaces

As advertised

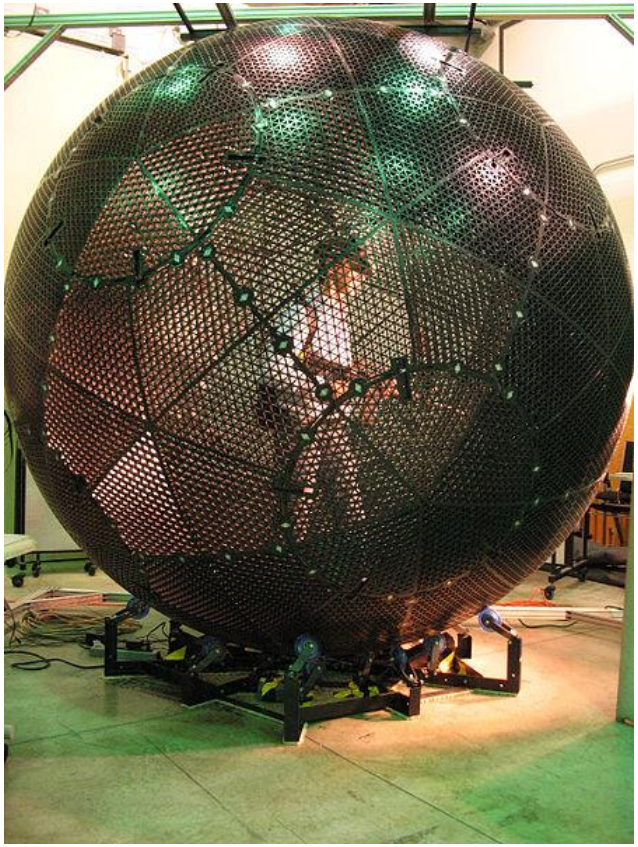
https://www.youtube.com/watch?v=AZ9mA34Bzw0

As advertised?

https://www.youtube.com/watch?v=MPSqM-g7_r0

Locomotion interfaces

VirtuoSphere



http://www.youtube.com/watch?v=NmpOQZgHUMo

Cybersphere

https://www.researchgate.net/profile/Vinesh_Raja/publication/220425224_Cybersphere_The_fully_immersive_spherical_projection_system/links/02e7e5267d19844e85000000.pdf

Locomotion interfaces

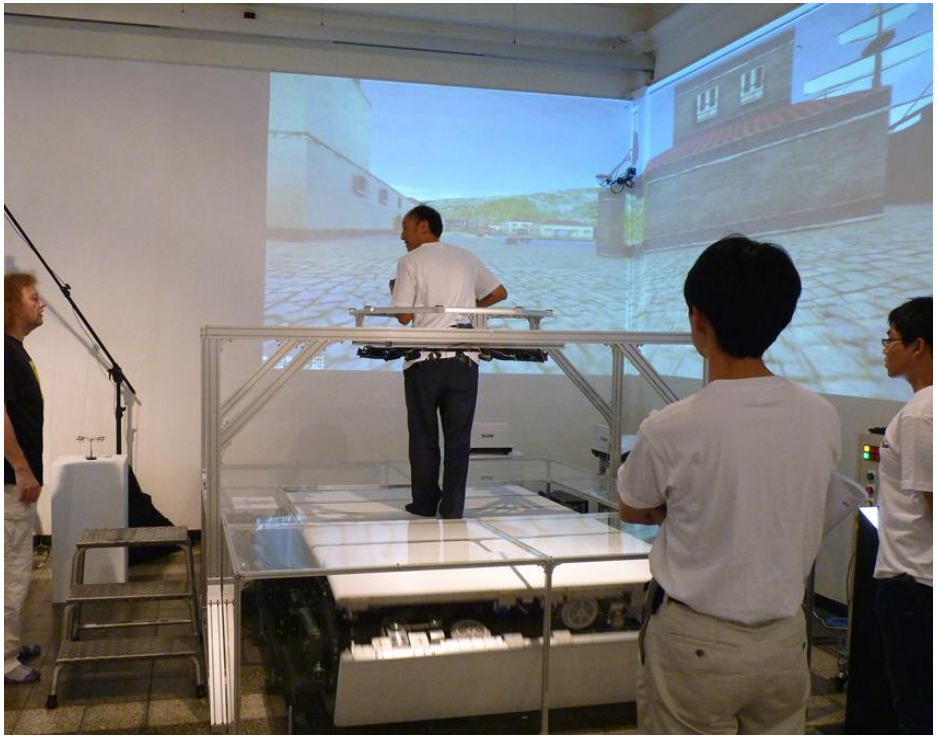
CirculaFloor

University of Tsukuba
筑波大学

Iwata, H (2013). Locomotion Interfaces. In F. Steinicke, Y. Visell, J. L. Campos, & A. Lécuyer (Eds.), Human Walking in Virtual Environments: Perception, Technology, and Applications (pp. 113-144). New York: Springer Verlag. http://mcgill.worldcat.org/oclc/844194290

Locomotion interfaces

Torus treadmill



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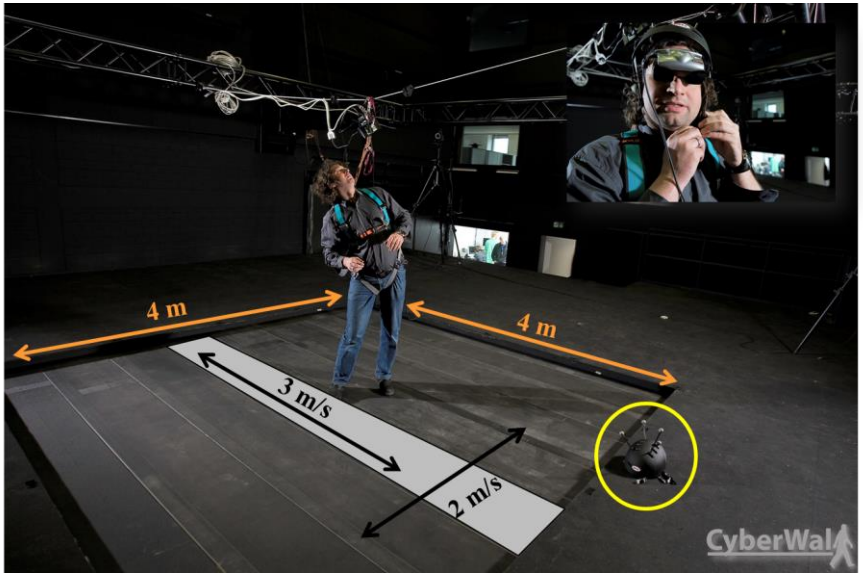
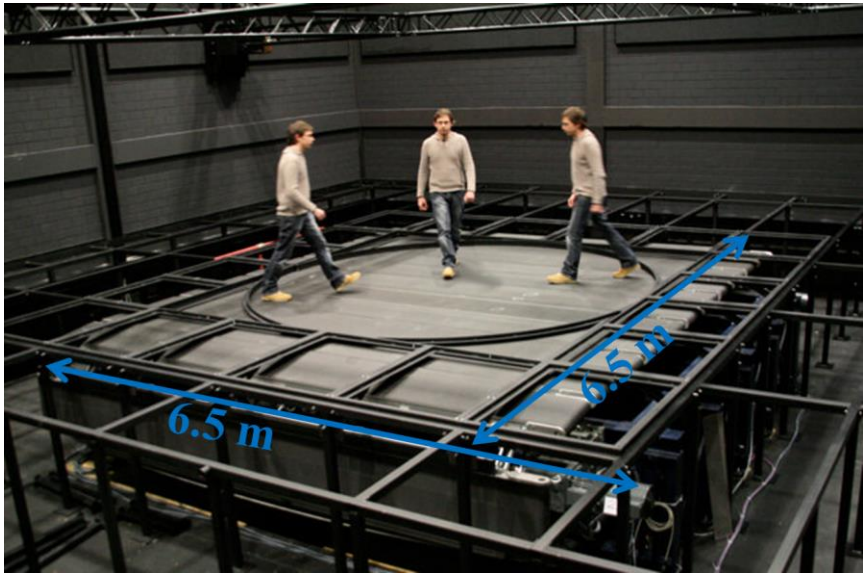
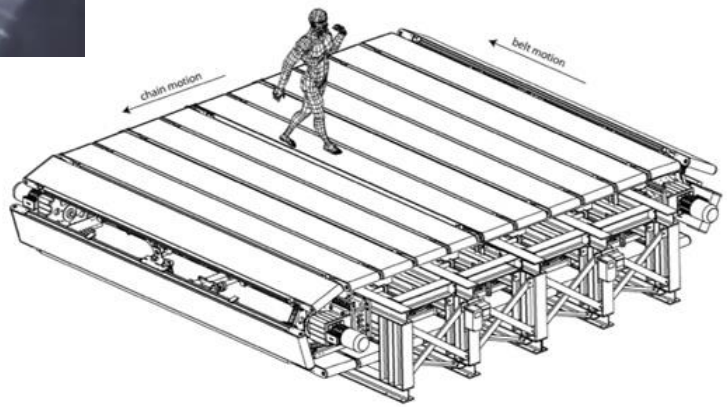
CyberWalk





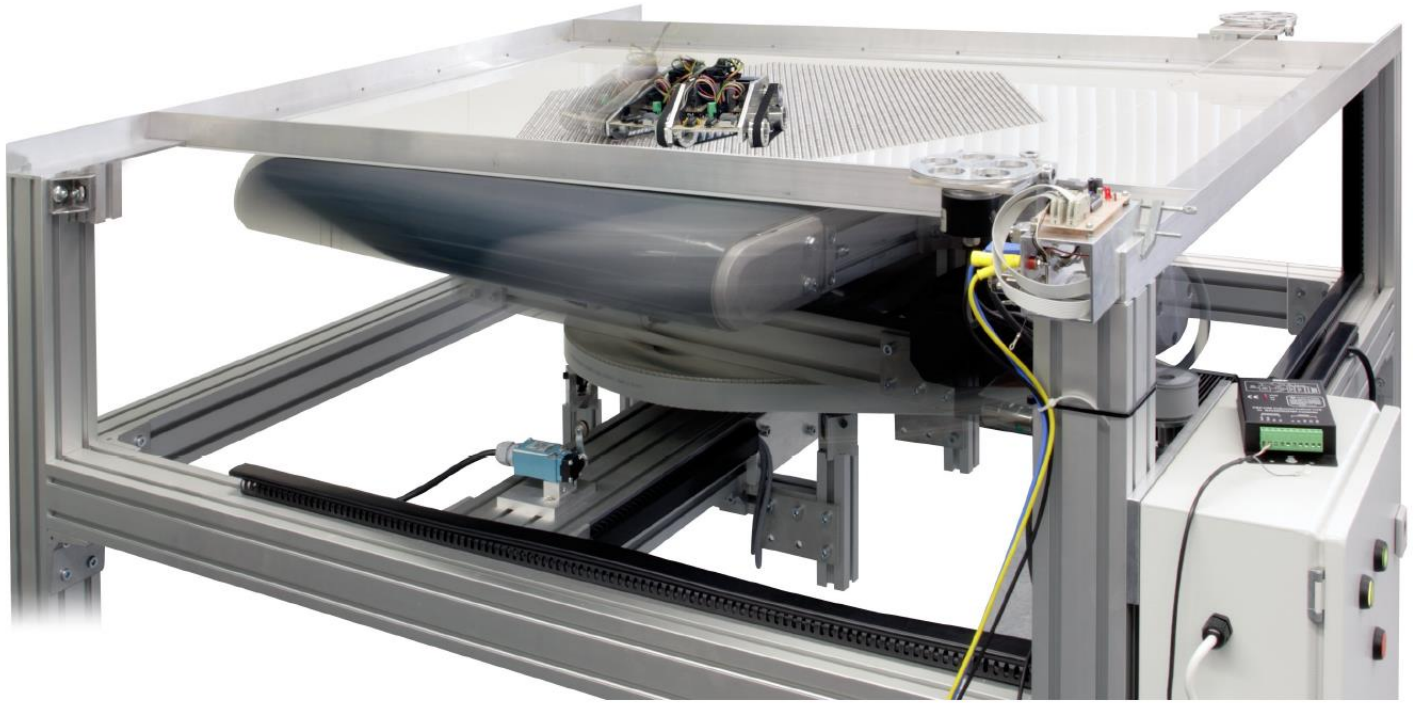
Frissen, I. et al. (2013). Enabling unconstrained omnidirectional walking through virtual environments: an overview of the CyberWalk project. In F. Steinicke, Y. Visell, J. L. Campos, & A. Lécuyer (Eds.), Human Walking in Virtual Environments: Perception, Technology, and Applications (pp. 113-144). New York: Springer Verlag. http://mcgill.worldcat.org/oclc/844194290



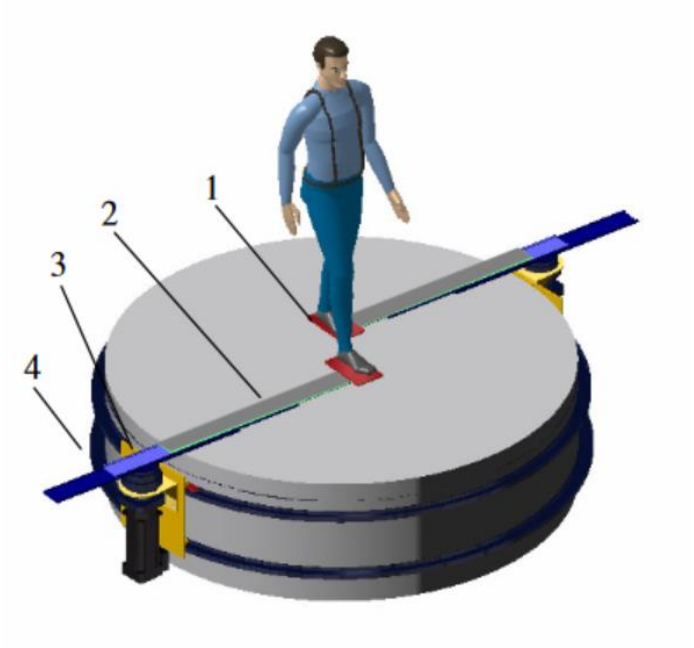
https://www.youtube.com/watch?v=moq1Dclza90
https://www.youtube.com/watch?v=Af0Skxi4ftw

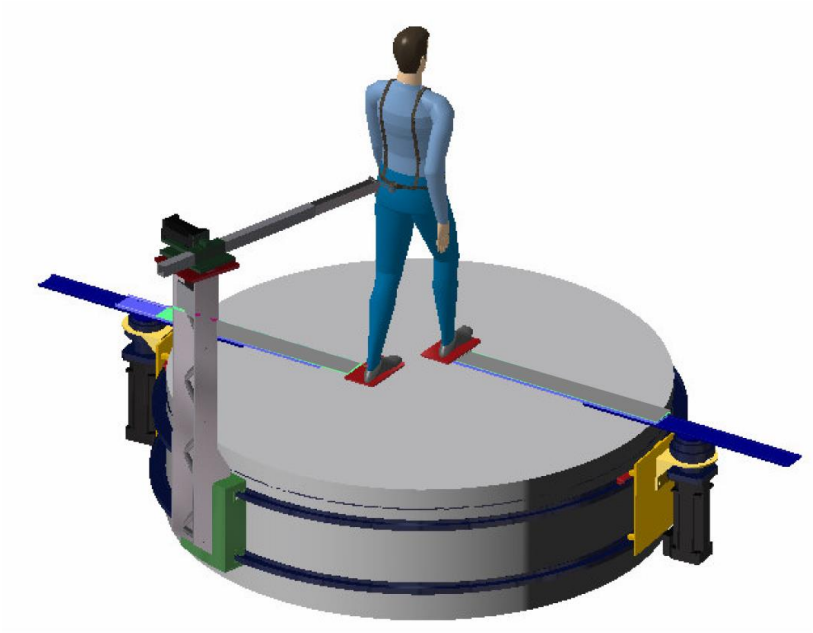
CyberWalk

Cybercarpet



M. C. Schwaiger, T. Thummel and H. Ulbrich, "A 2D-Motion Platform: The Cybercarpet," Second Joint EuroHaptics Conference and Symposium on Haptic Interfaces for Virtual Environment and Teleoperator Systems (WHC'07), Tsukaba, 2007, pp. 415-420. doi: 10.1109/WHC.2007.1
http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=4145210&isnumber=4145131





Schwaiger, M., Ulbrich, H., & Thümmel, T. (2006). A foot following locomotion device with force feedback capabilities. In *Proceedings of VIII Symposium on virtual Reality* (pp. 309-321).

https://www.digitalartsonline.co.uk/news/interactive-design/chi-2015-you-can-climb-virtual-stairs-with-these-real-boots/

In short

- Designing for natural interaction requires understanding natural interaction
- Natural interaction starts with the body, not vision or audition
- Body includes haptics and locomotion

Haptics

- Touch is typically considered less important than vision|hearing; but in a way it is the most important
  - While you can live relatively easily without vision and/or hearing, but you cannot live without touch
- Touch is extremely robust
  - It's extremely rare to not be able to feel touch
- We should consider designing interfaces that allow us to interact with virtual environments through haptics

Locomotion

- Walking one of the natural ways in which we engage with our environment
- We should consider designing interfaces that allow us to walk through virtual environments in a natural and unconstrained manner
  - Easier said than done