“Human Factors Issues in Virtual Environments”

by Stanney, Mourant, and Kennedy

Humans & Automation Seminar

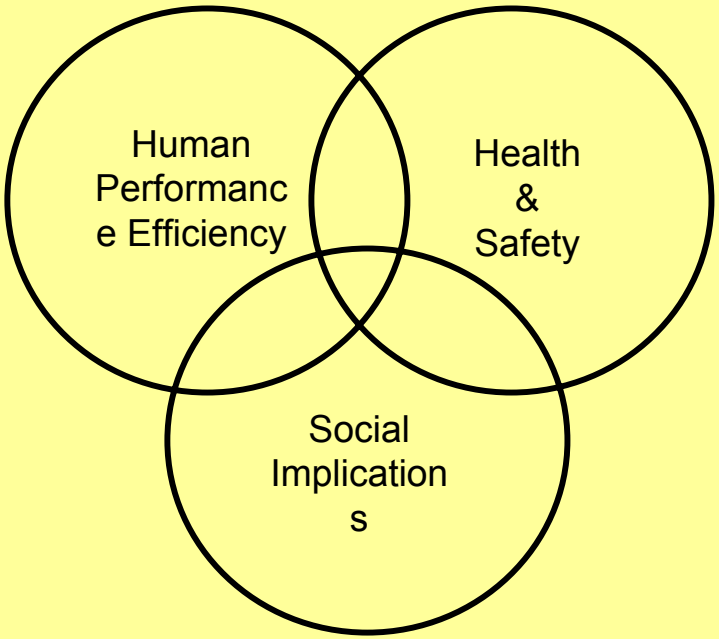
Jessica J. Márquez

April 10, 2002

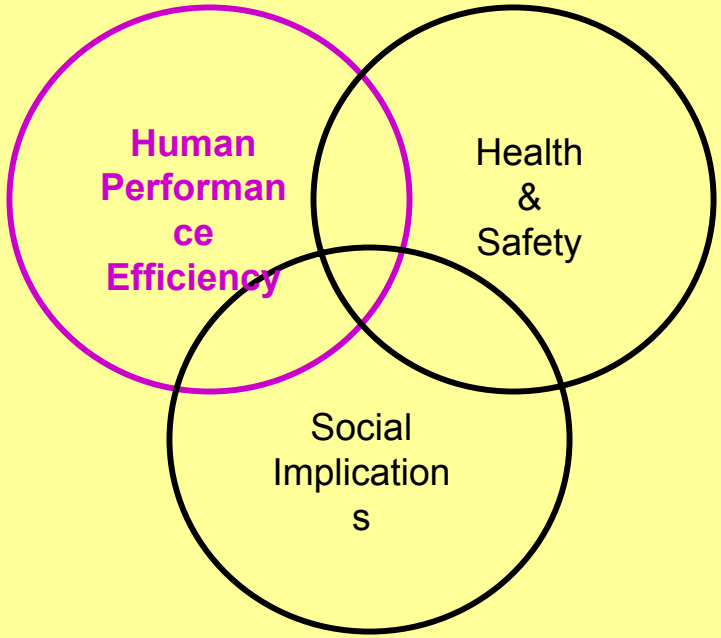
Overview: Human Factors in VR

- Paper: review of literature as of 1998
- Extra information inserted (noted with *)
  - Additional insight welcome!
- Watch out for acronyms
  - VR : virtual reality
  - VE : virtual environments
- Discussion/Questions

Organization



- Human performance efficiency in virtual worlds
- Health and safety issues
- Potential social implications of VE technology


Human Performance Efficiency
Health & Safety
Social Implications

Human Performance Efficiency

- "minimize the learning required to operate within [VE], but maximize the information yield" (Wann and Mon-Williams 1996)
- Function of : TASK and USER
- Move away from trial-and-error and focus on controlling the factors that contribute to human performance in VEs

Human Performance Efficiency

- Factors: navigation complexity, presence, and benchmark tests
- Task Characteristics
- User Characteristics
- Human Sensory Limitations
- Integration Issues: Multimodal Interaction
- VE Design Metaphors

1. Navigational Complexity

- Performance depends→navigation tools and techniques to maintain spatial orientation
- Means of measuring “navigational complexity”?
- Solution: applying technical knowledge from other fields
  - Mental maps, wayfinding, time to collision, geographical orientation, vestibular functions

2. Degree of Presence

- Definition?
  - "vividness of an experience and the level of interaction" (Sheridan 1992; Steuer 1992)
  - *Draper et al. 1998: "a mental state in which a user feels physically present within the computer-mediated environment" : "**being there**" -- not just immersion.

2. Degree of Presence ..cont

- However, **not proven** that higher presence will increase performance
- How measure without affecting presence?
  - Lack of a concrete definition
  - Questionnaires : have lost the moment
  - Stanney suggests determining level of vividness/fidelty and interaction -- but is this presence?

3. Users' performance on tests

- How well were users able to:
  - Move in VE
  - Manipulate objects
  - Respond to force feedback
  - Perform visual tasks

Influence of Task

- Problem matching VR benefits with task
- Is there a benefit from using:
  - Stereoscopic 3-D : yes, if complex task
  - Real-time interactivity : useful but increases workload
  - Immersion : little empirical data; task specific

Influence of User

- Level of experience
  - Influences skills and manner in which task is understood and organized
- Human cognitive abilities
  - Spatial visualization, orientation, memory, mental rotation ability
  - Affects motion and manipulation of objects
- Others: personality, age

Human Sensory Limitations (1)

- Visual perception
  - Small anomaly is very obvious
  - Field of view limited by HMD (perception of motion affected)
  - Resolution limitations
  - Determination of stereopsis
- Auditory perception
  - Horizontal, okay; vertical, needs development.

Human Sensory Limitations (2)

- Limitation is the lack of VR that includes haptic and kinesthetic feedback
  - Enhanced performance
- Haptic perception
  - Touch: Sensations of the skin, vibrotactile thresholds
- Kinesthetic perception (position of joints and muscles)

Human Sensory Limitations* (3)

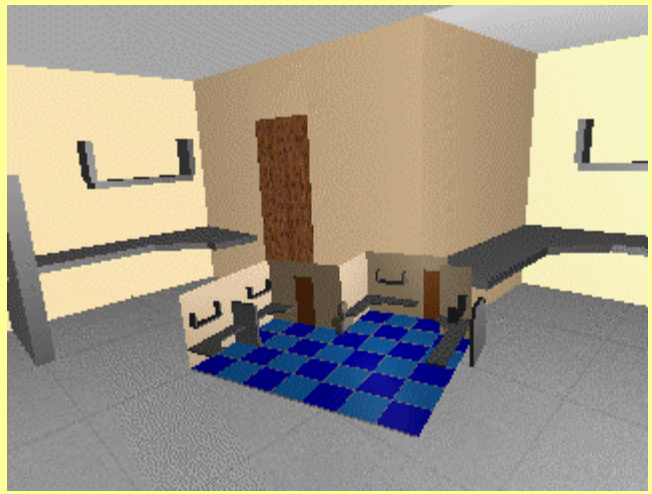
- Vestibular perception also needed
  - Lack of vestibular inputs contributes to disorientation
    - *Without, rotations are misperceived in VR*
  - Can supplement with haptic and kinesthetic feedback

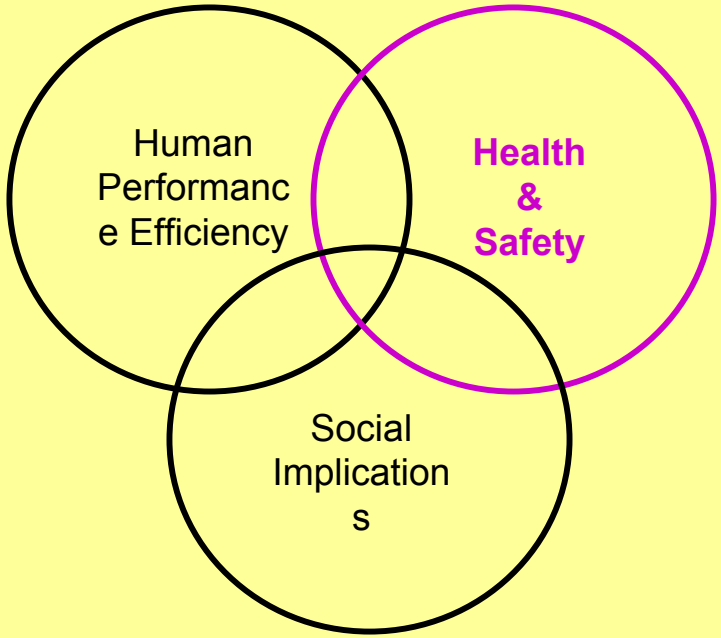
Multimodal Interaction Issues

- Sensorial redundancy enhance performance
- Amount and which ones are yet to be determined
  - Can the human handle all the inputs?
  - May lead to “sensorial confusion”

VE Design Metaphors

- Need for effective VE metaphors
  - Navigation use in particular benefited
- Much like for computer operating systems have:
  - Windows, desktop
- Example: map cubes




Human
Performanc
e Efficiency
Health
&
Safety
Social
Implication
s

Health and Safety Issues (1)

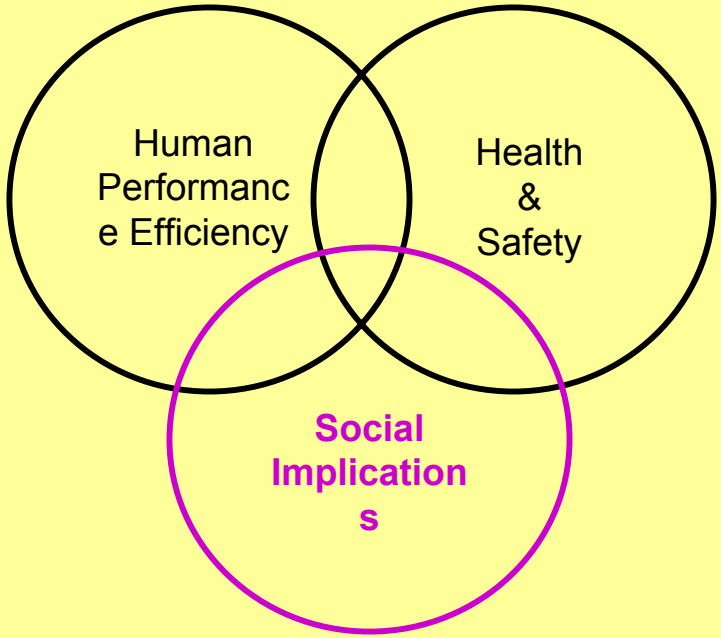
- Direct Microscopic Effects
  - HMD
    - *Eyes affected by emf → cataracts*
    - *May lead to unstable binocular vision, reduced visual acuity*
    - ***Weight/position→head, neck, and/or spine could be harmed***
  - Phobic effects (HMD enclosure, anxiety)
  - Exposure to high volume audio
  - Carpal tunnel syndrome

Health and Safety Issues (2)

- Direct Macroscopic Effects
  - Limited/eliminated vision of natural surroundings could lead to falls, trips
- Aftereffects:
  - Head spinning, postural ataxia, reduced eye-hand coordination, vestibular disturbances, and/or sickness. But after how long?*
    - **Author does not comment on severity: mild?*
    - *Limits post-VR ability to function normally.*

Cybersickness = Motion sickness

- Susceptibility changes between individuals
  - Conflict of sensory inputs: **rotations without the vestibular/kinesthetic cues*
  - Factors: FOV, vection, lag, HMD weight
- Predetermine susceptible subjects
  - Mental rotation tests? *Not in my experience.
- Partial solution: more navigation control
  - *Vestibular/kinesthetic feedback


Human Performanc e Efficiency
Health & Safety
Social Implication s

Social Impact of VTechnology

- Use of violence
  - Could “engender addiction and subtly condition to violence”
  - “Active engagement [rather than passive] can have better retention of learned skills”
- *These issues hold true for current methods of entertainment.
  - Isn’t better retention a positive quality -- when used appropriately?

Other Social Issues

- *Interaction between distant VR users within groups
- *Interaction between VR “people” and us
- “Will people avoid reality and real social encounters with peers and become addicted to escapism?”
- “How will VE influence young children… liable to psychological and moral influence?”

Discussion/Questions

- *Authors seem to paint a pretty grim picture of virtual reality technology. Do you agree?
  - Do you agree with some of the social issues they came up with?