ARIVE

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

MONASH University

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

VICTORIA UNIVERSITY WELLINGTON
TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

University of South Australia

ARIVE Lecture Series
XR: Virtual and Augmented Reality

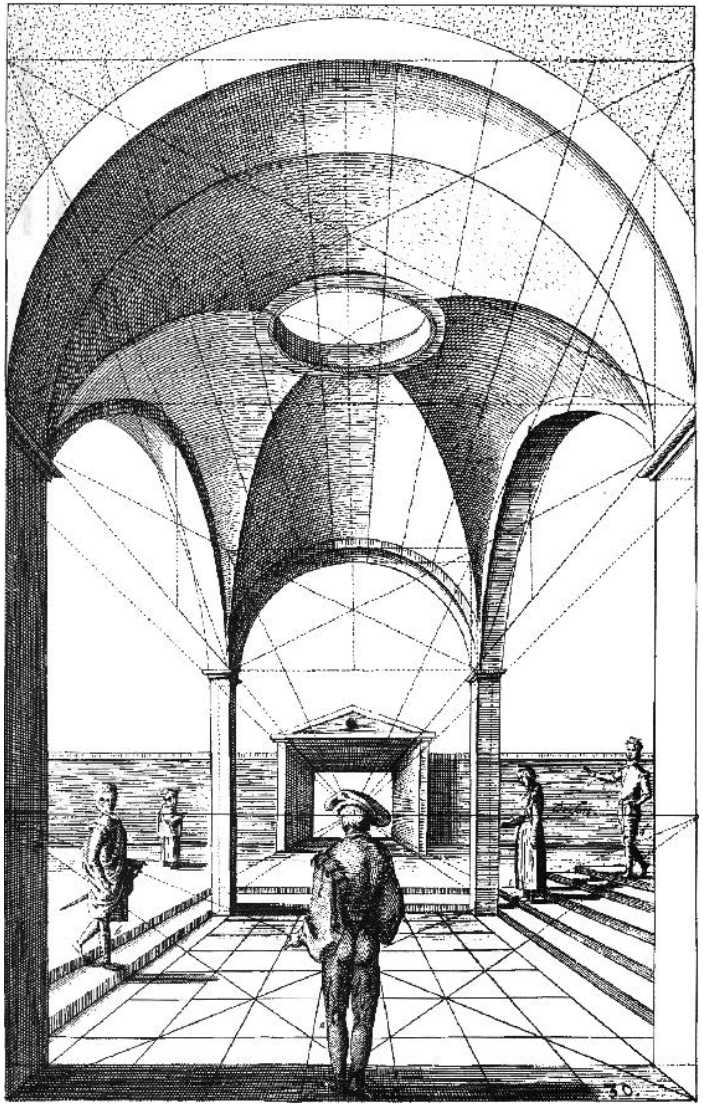
Presence

Holger Regenbrecht
University of Otago, Dunedin, New Zealand

ARIVE

Outline

1. Virtual Reality
2. Immersion and Presence
3. Measuring Presence
4. Social and Co-Presence
5. Telepresence
6. MR Presence



ARIVE

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

MONASH University

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

VICTORIA UNIVERSITY WELLINGTON
TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

University of South Australia

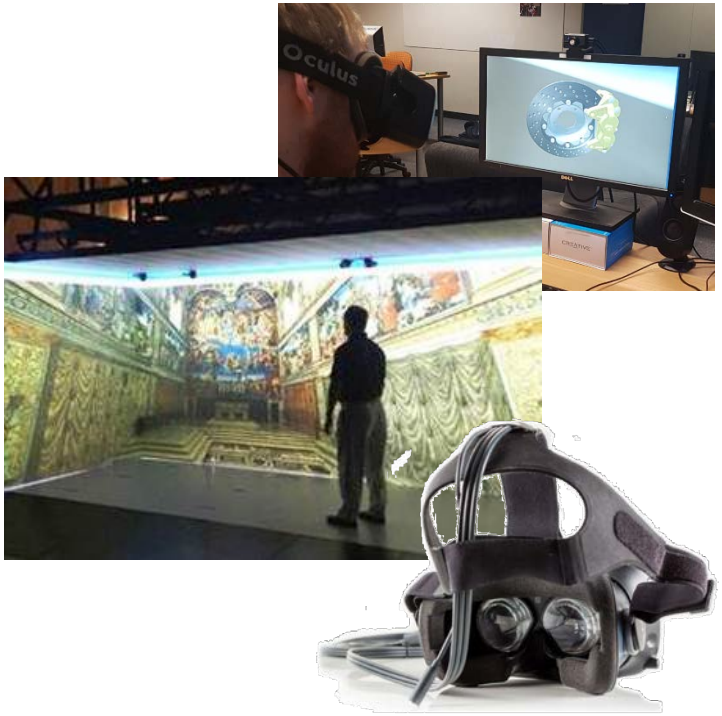
Virtual Reality

ARIVE

Virtual Reality

Concept

Technology



ARIVE

Virtual and Augmented Reality

- Computer generated environment
- Three-dimensional
- Interactive with real-time feedback
- *Sense of presence*

+

- Real Environment
- Spatially aligned VR
- *Impression of one environment*

Virtual Reality

Augmented Reality

ARIVE

Virtual Reality

VR?

movieweb.com

ARIVE

Virtual Reality

VR?

vrscout.com

ARIVE

Virtual Reality

VR?

virtualorator.com

Presence

fc-union-berlin.de

ARIVE

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

MONASH University

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND
SAPERE AUDE

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

VICTORIA UNIVERSITY WELLINGTON
TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

University of South Australia

Immersion and Presence

Holger's WRONG Idea (mid/late 90's)

Immersion = {

frame rate

sgi or e&s

latency

rotdeg/sec

ppi

number of polygons

hmd resolution

update rate

triangles/sec

clipping

tracking accuracy

colour space

field of view

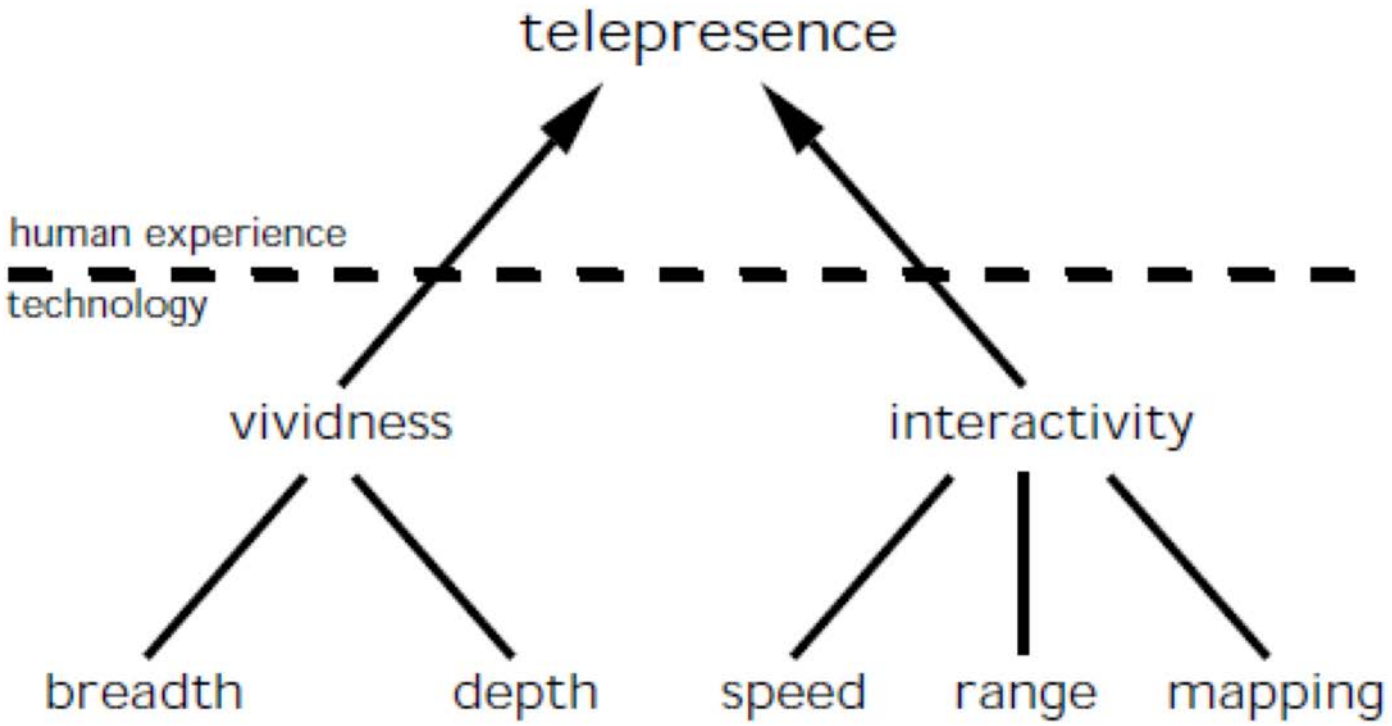
tracking range

...

}

ARIVE

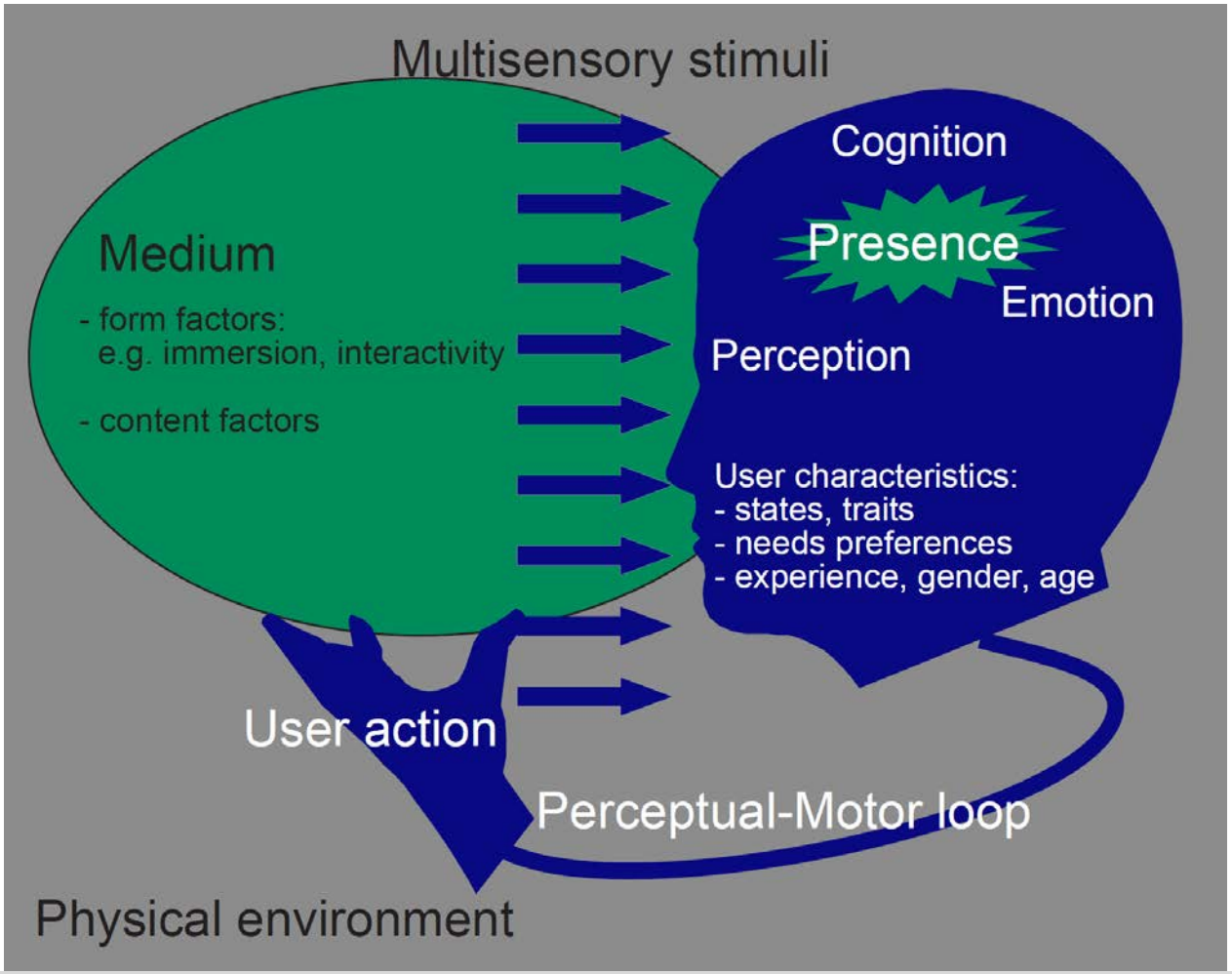
Presence



Steuer, J. (1992). Defining virtual reality: Dimensions determining telepresence. *Journal of communication, 42*(4), 73-93.

ARIVE

Presence



IJsselsteijn, W. and Riva, G.: 2003, Being there: The experience of presence in mediated environments., in W. I. G. Riva, F. Davide (ed.), Being There: Concepts, effects and measurement of user presence in synthetic environments, Ios Press, pp. 4–14.

ARIVE

Presence

PHILOSOPHICAL TRANSACTIONS OF THE ROYAL SOCIETY B

Phil. Trans. R. Soc. B (2009) **364**, 3549–3557
doi:10.1098/rstb.2009.0138

Place illusion and plausibility can lead to realistic behaviour in immersive virtual environments

Mel Slater[1,2,*]

[1]*EVENT Lab, Institute for Brain, Cognition and Behavior (IR3C), ICREA-University of Barcelona, 08035 Barcelona, Spain*
[2]*Department of Computer Science, University College London, London WCIE 6BT, UK*

In this paper, I address the question as to why participants tend to respond realistically to situations and events portrayed within an immersive virtual reality system. The idea is put forward, based on the experience of a large number of experimental studies, that there are two orthogonal components that contribute to this realistic response. The first is 'being there', often called 'presence', the qualia of having a sensation of being in a real place. We call this place illusion (PI). Second, plausibility illusion (Psi) refers to the illusion that the scenario being depicted is actually occurring. In the case of both PI and Psi the participant knows for sure that they are not 'there' and that the events are not occurring. PI is constrained by the sensorimotor contingencies afforded by the virtual reality system. Psi is determined by the extent to which the system can produce events that directly relate to the participant, the overall credibility of the scenario being depicted in comparison with expectations. We argue that when both PI and Psi occur, participants will respond realistically to the virtual reality.

Presence

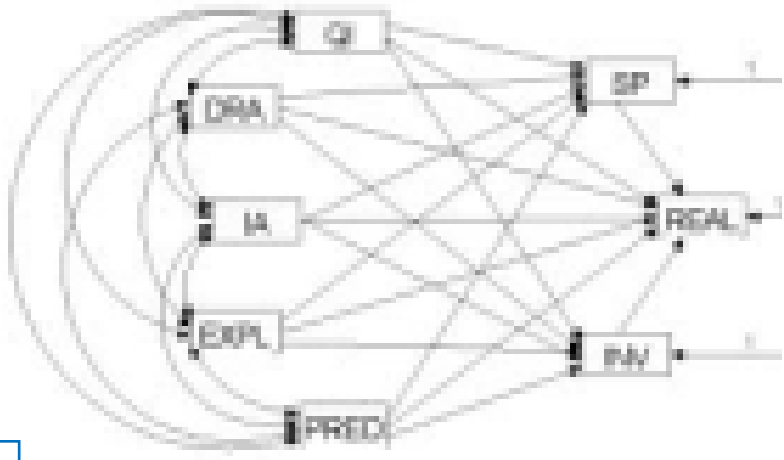
Quality of Immersion

Drama

Interface Awareness

Exploration

Predictability



Spatial Presence

Realism

Involvement

Regenbrecht, H. (2000). Faktoren fuer Praesenz in Virtueller Architektur. PhD Thesis. Bauhaus-University, Weimar, Germany.

ARIVE

The Presence Illusion

Regenbrecht, H., & Schubert, T. (2002). Real and illusory interactions enhance presence in virtual environments. *Presence: Teleoperators & Virtual Environments*, *11*(4), 425-434.

ARIVE

Immersion

Control

- Display Types
- Resolution
- Field of View
- Display frame rate
- Latency
- Noise/jitter
- …

Measure

- units (specs, measured)
- Perceived Fidelity
- Perceived Surroundedness
- “Fluidity” of interface
- Perceived Flicker
- …

ARIVE

Presence

Control

- Immersion Factors
- Plot / Drama
- Interactivity
- Coherence
- Influence the suspension of disbelief
- …

Measure

- Subjectively reported
  - Presence,
  - Co-Presence,
  - Social Presence, …
- Observed
  - Actions,
  - Breaks, …
- Measured
  - Heart rate,
  - GSR, …

Immersion and Presence [abbreviated]

immersion:= fidelity of technical surroundedness

sense of presence := sense of being there

ARIVE

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

MONASH University

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

VICTORIA UNIVERSITY WELLINGTON
TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

University of South Australia

Measuring Presence

ARIVE

Presence Measures

Self Report

(questionnaires, interviews, focus groups, …)

Measures of PRESENCE

(spatial, social, co-, tele-, …)

Observation

(video recordings, raters, coding, …)

Physiological

(eye gaze, GSR, HR, EEG, fMRI, …)

ARIVE

Presence Measures::Self-Report

The Factor Structure of the Presence Questionnaire

Bob G. Witmer
U.S. Army Research Institute for the Behavioral and Social Sciences
Simulator Systems Research Unit
Orlando FL 32826-3276 USA

Christian J. Jerome
University of Central Florida
Consortium Research Fellows Program

Michael J. Singer
U.S. Army Research Institute for the Behavioral and Social Sciences
Simulator Systems Research Unit
Orlando FL 32826-3276 USA
Michael.Singer@peostri.army.mil

Abstract

Constructing a valid measure of presence and discovering the factors that contribute to presence have been much sought after goals of presence researchers and at times have generated controversy among them. This paper describes the results of principal-components analyses of Presence Questionnaire (PQ) data from 325 participants following exposure to immersive virtual environments. The analyses suggest that a 4-factor model provides the best fit to our data. The factors are Involvement, Adaptation/Immersion, Sensory Fidelity, and Interface Quality. Except for the Adaptation/Immersion factor, these factors corresponded to those identified in a cluster analysis of data from an earlier version of the questionnaire. The existence of an Adaptation/Immersion factor leads us to postulate that immersion is greater for those individuals who rapidly and easily adapt to the virtual environment. The magnitudes of the correlations among the factors indicate moderately strong relationships among the 4 factors. Within these relationships, Sensory Fidelity items seem to be more closely related to Involvement, whereas Interface Quality items appear to be more closely related to Adaptation/Immersion, even though there is a moderately strong relationship between the Involvement and Adaptation/Immersion factors.

I Introduction

A Cross-Media Presence Questionnaire:
The ITC-Sense of Presence Inventory

Jane Lessiter
Jessiter@gold.ac.uk

Jonathan Freeman
j.freeman@gold.ac.uk

Edmund Keogh
Jules Davidoff
Department of Psychology
Goldsmiths College
University of London
New Cross, London SE14 6NW
United Kingdom

Abstract

I Introduction

I.1 Defining Presence

Depth of Presence in Virtual Environments

Mel Slater, Martin Usoh, Anthony Steed,
Department of Computer Science, and
London Parallel Applications Centre,
QMW, University of London,
Mile End Road,
London E1 4NS, UK.

Abstract

This paper describes a study to assess the influence of a variety of ... level of presence in immersive virtual environments. It introduces ... depth", that is, where a participant can simulate the process of ... environment while already in such an environment, which can be repeated to several levels of depth. An experimental study including 24 subjects was carried out. Half of the subjects were transported between environments by using virtual Head-mounted displays, and the other half by going through doors. Three other binary factors were: whether or not gravity operated, whether or not the subject experienced a virtual precipice, and whether or not the subject was followed around by a virtual actor. Visual, auditory and kinesthetic representation systems, and egocentric/exocentric perceptual positions were assessed by a pre-experiment questionnaire. Presence was assessed by the subjects as their sense of "being there", the extent to which they experienced the virtual environments as more the presenting reality than the real world in which the experiment was taking place, and the extent to which the subject experienced the virtual environments as places visited rather than images seen. A logistic regression analysis revealed that subjective reporting of presence was significantly positively associated with visual and kinesthetic representation systems, and negatively with the auditory system. This was not surprising since the virtual reality system used was primarily visual. The analysis also showed a significant and positive association with stacking level depth for those who were transported between

1

The Experience of Presence: Factor Analytic Insights

Thomas Schubert
schubert@igroup.org
Friedrich-Schiller-University
Humboldtstr. 26
07743 Jena, Germany

Frank Friedmann
igroup.org
Leipzig, Germany

Holger Regenbrecht
DaimlerChrysler Research and Technology
Ulm, Germany

Abstract

Within an embodied cognition framework, it is argued that presence in a virtual environment (VE) develops from the construction of a spatial-functional mental model of the VE. Two cognitive processes lead to this model: the representation of bodily actions as possible actions in the VE, and the suppression of incompatible sensory input. It is hypothesized that the conscious sense of presence reflects these two components as spatial presence and involvement. This prediction was confirmed in two studies (N – 246 and N – 296) assessing self-reports of presence and immersion experiences. Additionally, judgments of "realness" were observed as a third presence component. A second-order factor analysis showed a distinction between presence, immersion, and interaction factors. Building on these results, a thirteen-item presence scale consisting of three independent components was developed and verified using confirmatory factor analyses across the two studies.

Presence is a construct, a variable with various levels and dimensions.
Biocca and Delaney (1995, p. 62)

I Introduction

When we work or play within virtual environments (VEs), travel through them and interact with virtual objects, it is common that a certain sense of being in the virtual environment, or *presence*, develops. Except for cinema, where it is known as the *diegetic effect* (Burch, 1979), this experience is not that common in traditional media. In contrast, interactive media that present a three-dimensional space for the user, such as virtual reality and 3-D games, seem to be a reliable source of this experience. An example can illustrate this. When we read an article about a narrow suspension bridge, we would rarely experience any sensations because of the mentioned height, but we have a clear mental model of the described space. When we see the bridge in an action movie and we look down to the bottom of the valley together with the endangered protagonist, it is likely that we feel fear because of the height. However, when users have to walk over that bridge in a virtual environment, many of them will experience physiological symptoms and sensations of fear, because they have a sense of actually being there (Regenbrecht, Schubert, & Friedmann, 1998).

In this paper, we argue that all three examples basically build on the same cognitive processes. We will start with an analysis of the cognitive processes that lead to the emergence of presence. We will then show empirically that these cognitive processes surface in subjective experiences of presence.

Presence, Vol. 10, No. 3, June 2001, 266–281
© 2001 by the Massachusetts Institute of Technology

266 PRESENCE: VOLUME 10, NUMBER 3

...

ARIVE

Presence Measures::Self-Report

Authors	Year	Citations	Items
Banos et al. [1]	1998	181	77
Barfield & Weghorst [4]	1995	306	5+1
Cho et al. [10]	2003	37	4
Dinh et al. [9]	1999	434	13+1
Gerhard et al. [12]	2001	72	19+4
Kim & Biocca [14]	1997	722	8
Krauss et al. [15]	2001	11	42
Lombard & Ditton [17]	205	285	103
Lombard & Weinstein (TPI) [18]	120	116	4-8
Lessiter et al. (ITC-SOPI) [16]	2001	914	44
Nichols et al. [20]	2000	187	9
Nowak & Biocca [20]	2003	672	9
Schubert et al. (IPQ) [22, 23, 21]	**2001**	**953**	**14**
Usoh/Slater et al. (SUS) [27, 30]	1994/2000	1042/562	3/6
Witmer & Singer (WS) [32]	1998	4190	32

updated

Schwind, V., Knierim, P., Haas, N., & Henze, N. (2019, May). Using presence questionnaires in virtual reality. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (pp. 1-12).

Presence Measures::Self-Report.IPQ

Number	PQI/II Nr. (internal)	IPQ item name	shortcut	loading on ...	English question	English anchors	Copyright (item source)
1	s62	G1	sense of being there	PRES	In the computer generated world I had a sense of "being there"	not at all--very much	Slater & Usoh (1994)
2	s44	SP1	sense of VE behind	SP	Somehow I felt that the virtual world surrounded me.	fully disagree--fully agree	IPQ
3	s30	SP2	only pictures	SP	I felt like I was just perceiving pictures.	fully disagree--fully agree	IPQ
4	s28	SP3	not sense of being in v. space	SP	I did not feel present in the virtual space.	did not feel--felt present	???
5	s31	SP4	sense of acting in VE	SP	I had a sense of acting in the virtual space, rather than operating something from outside.	fully disagree--fully agree	IPQ
6	s33	SP5	sense of being present in VE	SP	I felt present in the virtual space.	fully disagree--fully agree	IPQ
7	s64	INV1	awareness of real env.	INV	How aware were you of the real world surrounding while navigating in the virtual world? (i.e. sounds, room temperature, other people, etc.)?	extremely aware-moderately aware-not aware at all	Witmer & Singer (1994)
8	s37	INV2	not aware of real env.	INV	I was not aware of my real environment.	fully disagree--fully agree	IPQ
9	s40	INV3	no attention to real env.	INV	I still paid attention to the real environment.	fully disagree--fully agree	IPQ
10	s38	INV4	attention captivated by VE	INV	I was completely captivated by the virtual world.	fully disagree--fully agree	IPQ
11	s48	REAL1	VE real (real/not real)	REAL	How real did the virtual world seem to you?	completely real--not real at all	Hendrix (1994)
12	s7	REAL2	experience similar to real env.	REAL	How much did your experience in the virtual environment seem consistent with your real world experience ?	not consistent-moderately consistent-very consistent	Witmer & Singer (1994)
13	s59	REAL3	VE real (imagined/real)	REAL	How real did the virtual world seem to you?	about as real as an imagined world--indistinguishable from the real world	Carlin, Hoffman, & Weghorst (1997)
14	s47	REAL4	VE wirklich	REAL	The virtual world seemed more realistic than the real world.	fully disagree--fully agree	IPQ

"[..] the IPQ questionnaire best reflects the construct of presence."

"[..] we recommend the IPQ questionnaire as the measure of presence as it provides the highest reliability within a reasonable timeframe."

Schwind, V., Knierim, P., Haas, N., & Henze, N. (2019, May). Using presence questionnaires in virtual reality. In Proceedings of the 2019 CHI Conference on Human Factors in Computing Systems (pp. 1-12).

ARIVE

Presence Self-Report Measures

Questionnaires, (Interviews, …) Limitations

- Difference between what people say and what they really think/experience
- Can feelings be expressed properly? (“How colourful was your day?” (Slater))
- Retrospective reporting (not while people experience presence)
- Inherent flaws in Likert scales (which most questionnaires use)

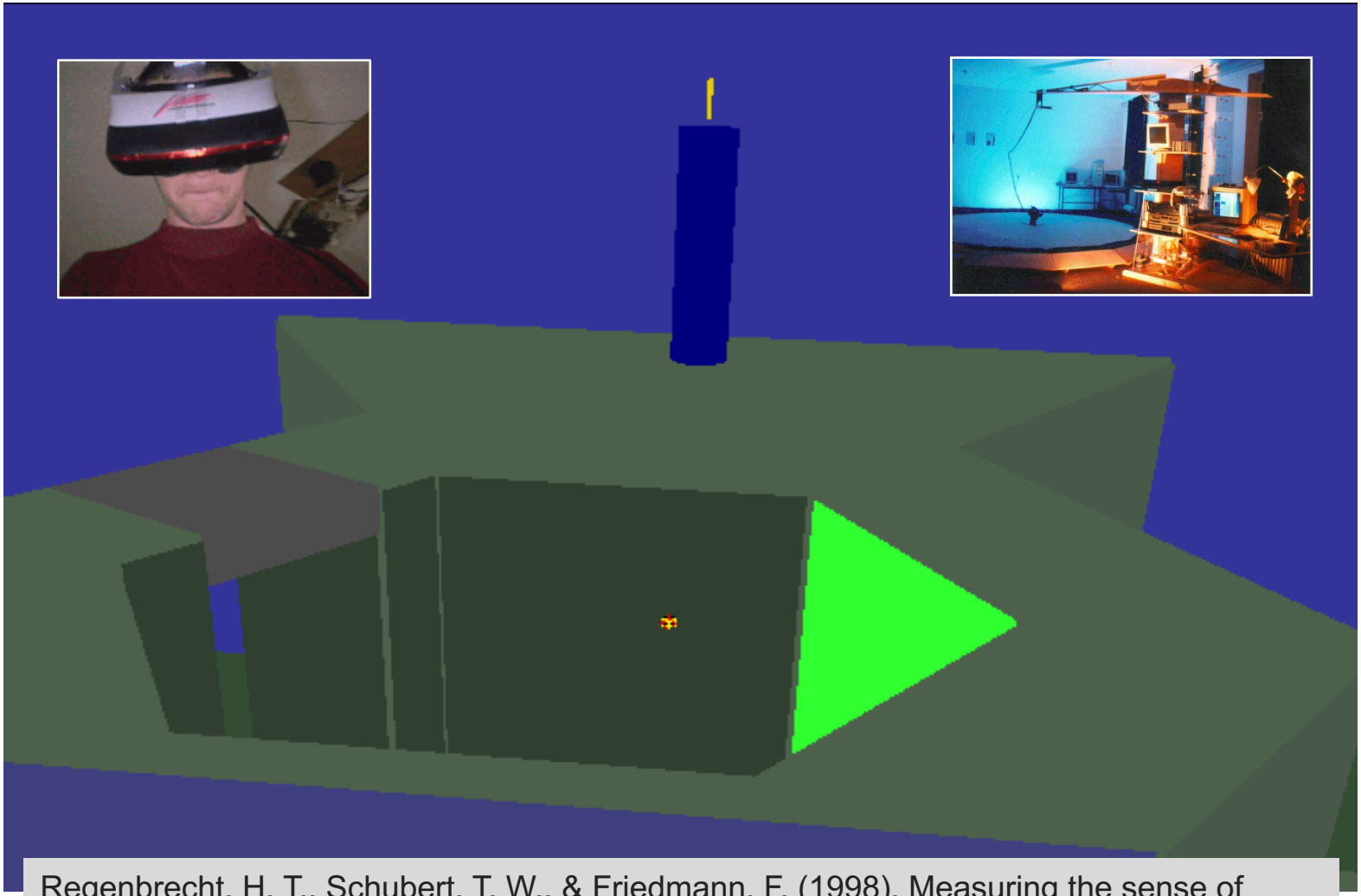
Presence Observational Measures

Real Actions in Virtual Environments

Mel Slater's Blog: presence-thoughts.blogspot.com

ARIVE

Real Actions in Virtual Environments



Regenbrecht, H. T., Schubert, T. W., & Friedmann, F. (1998). Measuring the sense of presence and its relations to fear of heights in virtual environments. *International Journal of Human-Computer Interaction*, *10*(3), 233-249.

ARIVE

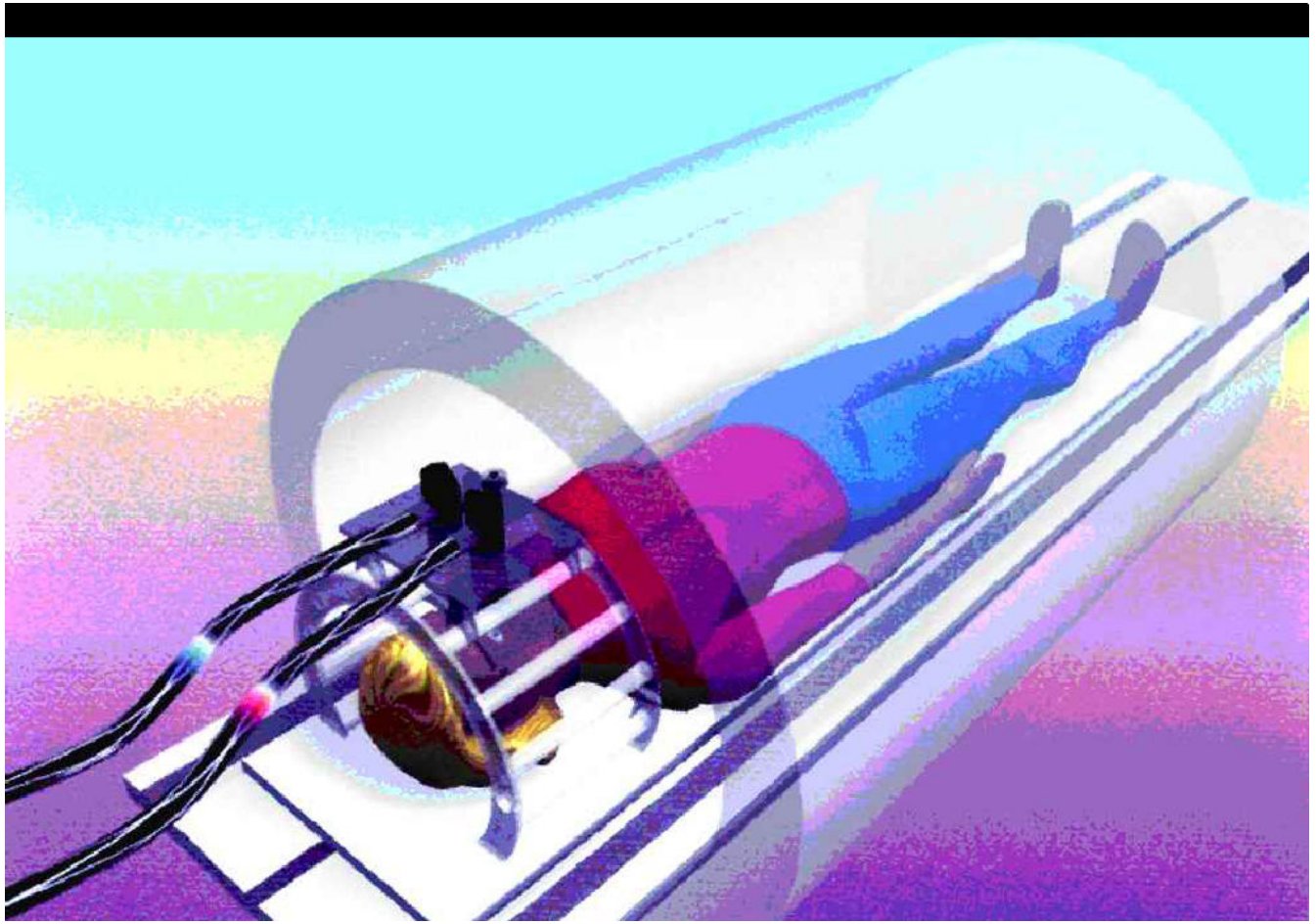
Presence Observational Measures

Real Actions in Virtual Environments Limitations

- Observable actions must have real-world equivalent
- Less suitable for unprepared (versus lab study) environments
- Limited to what is observable

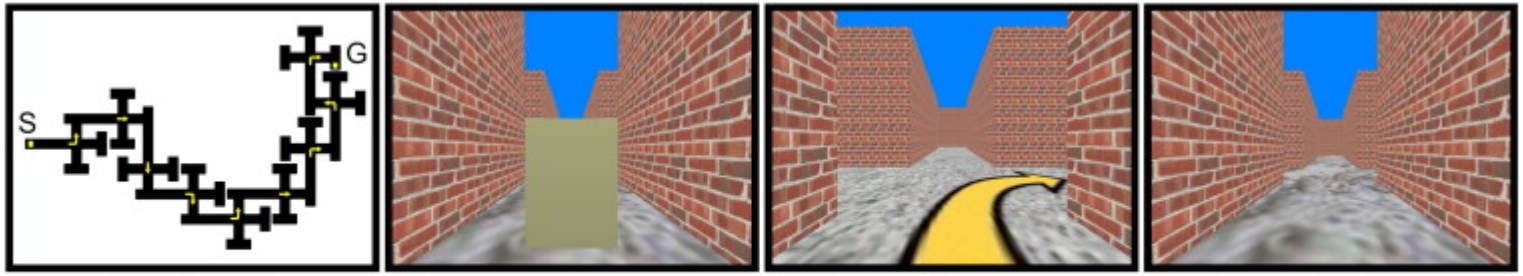
ARIVE

Presence – Physiological Measures



Hoffman, H. G., Richards, T., Coda, B., Richards, A., & Sharar, S. R. (2003). The illusion of presence in immersive virtual reality during an fMRI brain scan. CyberPsychology & Behavior, 6(2), 127-131.

Presence – Physiological Measures

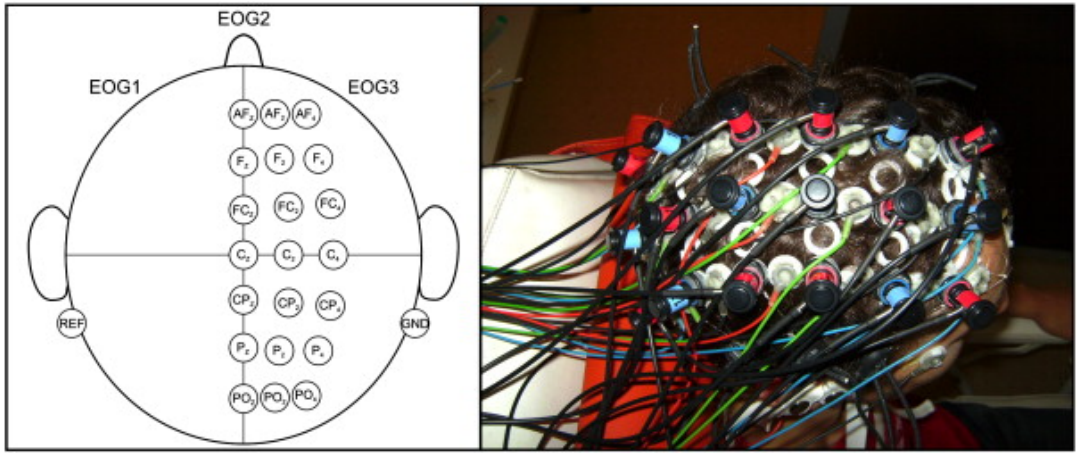


Floor plan of the maze (S: starting point, G: goal)

Box placed at every starting point

Arrows placed at the junctions in the learning phase

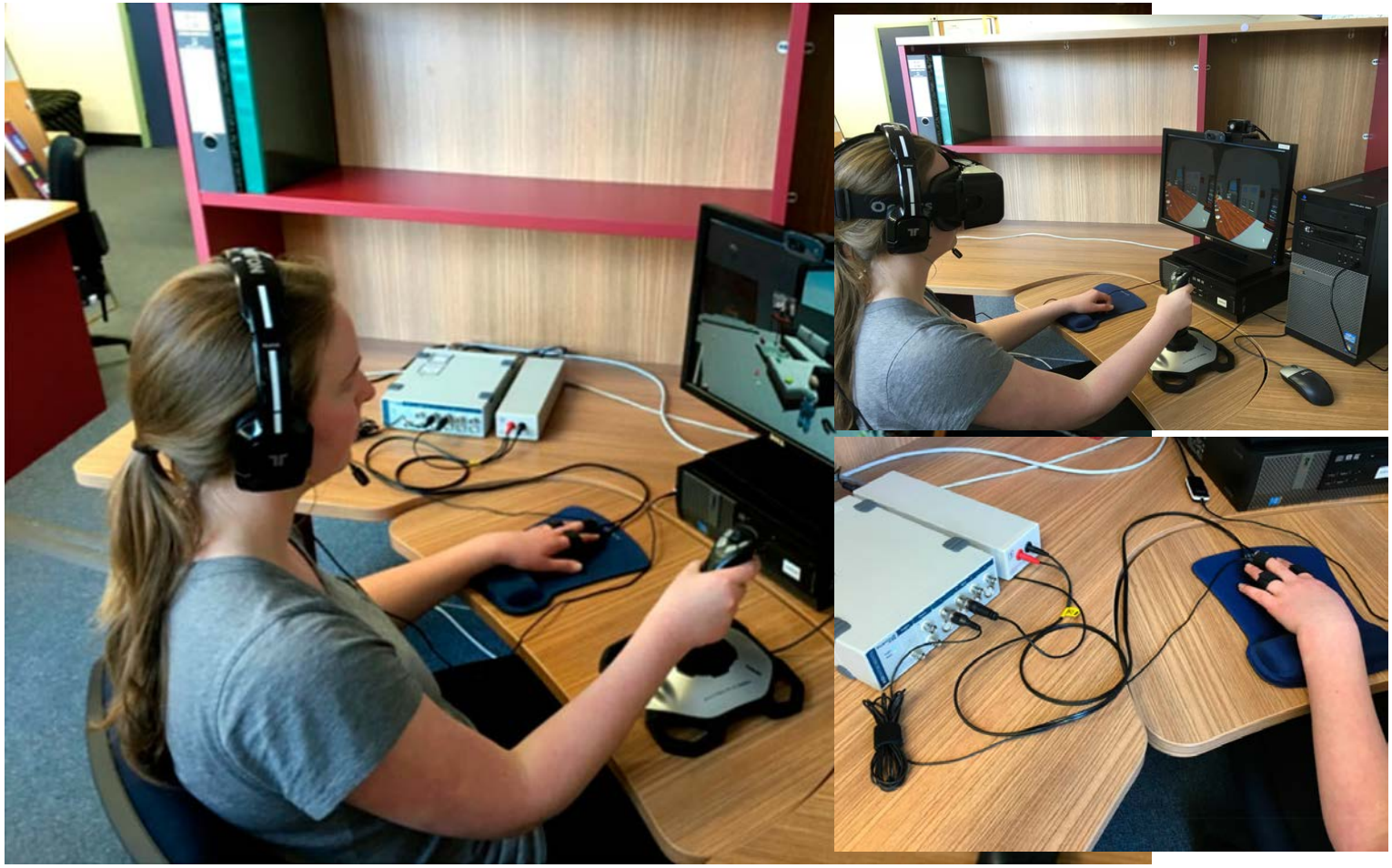
Maze without arrows at the junctions in the test phase



Kober, S. E., Kurzmann, J., & Neuper, C. (2012). Cortical correlate of spatial presence in 2D and 3D interactive virtual reality: an EEG study. International Journal of Psychophysiology, 83(3), 365-374.

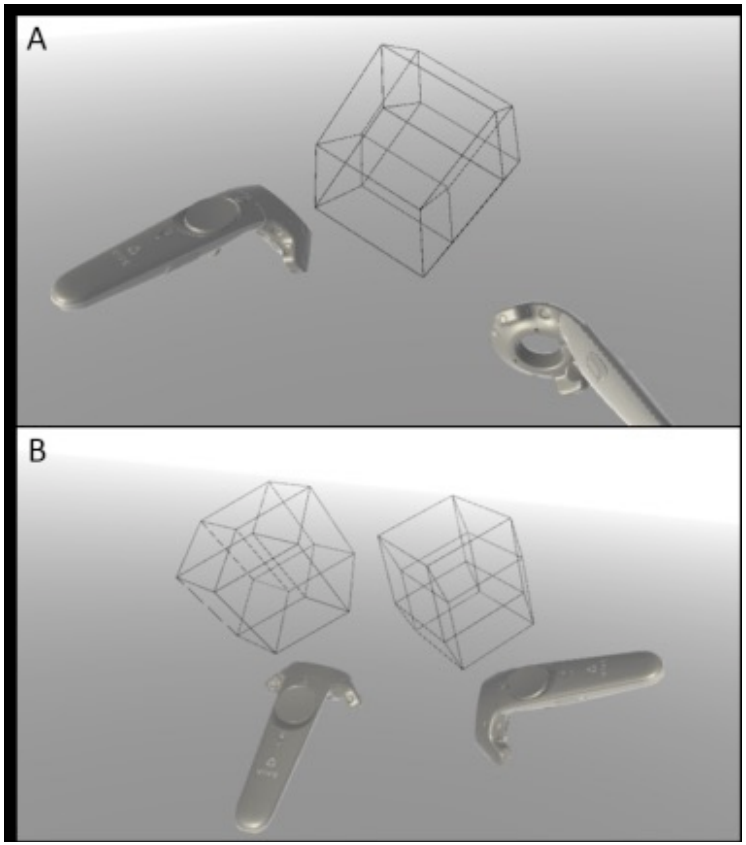
ARIVE

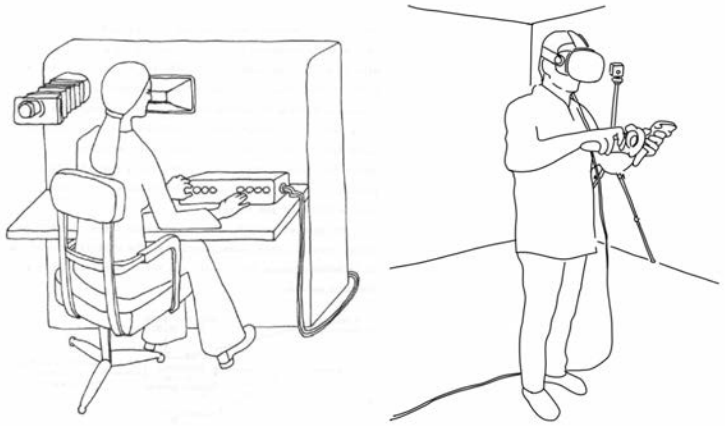
Presence – Physiological Measures



Alghamdi, M., Regenbrecht, H., Hoermann, S., & Swain, N. (2017). Mild stress stimuli built into a non-immersive virtual environment can elicit actual stress esponses. *Behaviour & Information Technology*, *36*(9), 913-934.

Presence – Combined Measures





Collins, J., Regenbrecht, H., Langlotz, T., Can, Y. S., Ersoy, C., & Butson, R. (2019, October). Measuring cognitive load and insight: A methodology exemplified in a virtual reality learning context. In *2019 IEEE International Symposium on Mixed and Augmented Reality (ISMAR)* (pp. 351-362). IEEE.

ARIVE

Presence Physiological Measures

EEG, GSR, fMRI, …
Limitations

- Need for instrumentation (esp. users)
- Noisy data
- You really, really need to know what you are measuring
- Careful modelling and analysis required
- Results/findings often borderline "esoteric" (cf Bennett, Miller, & Wolford, 2009)

ARIVE

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

MONASH University

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

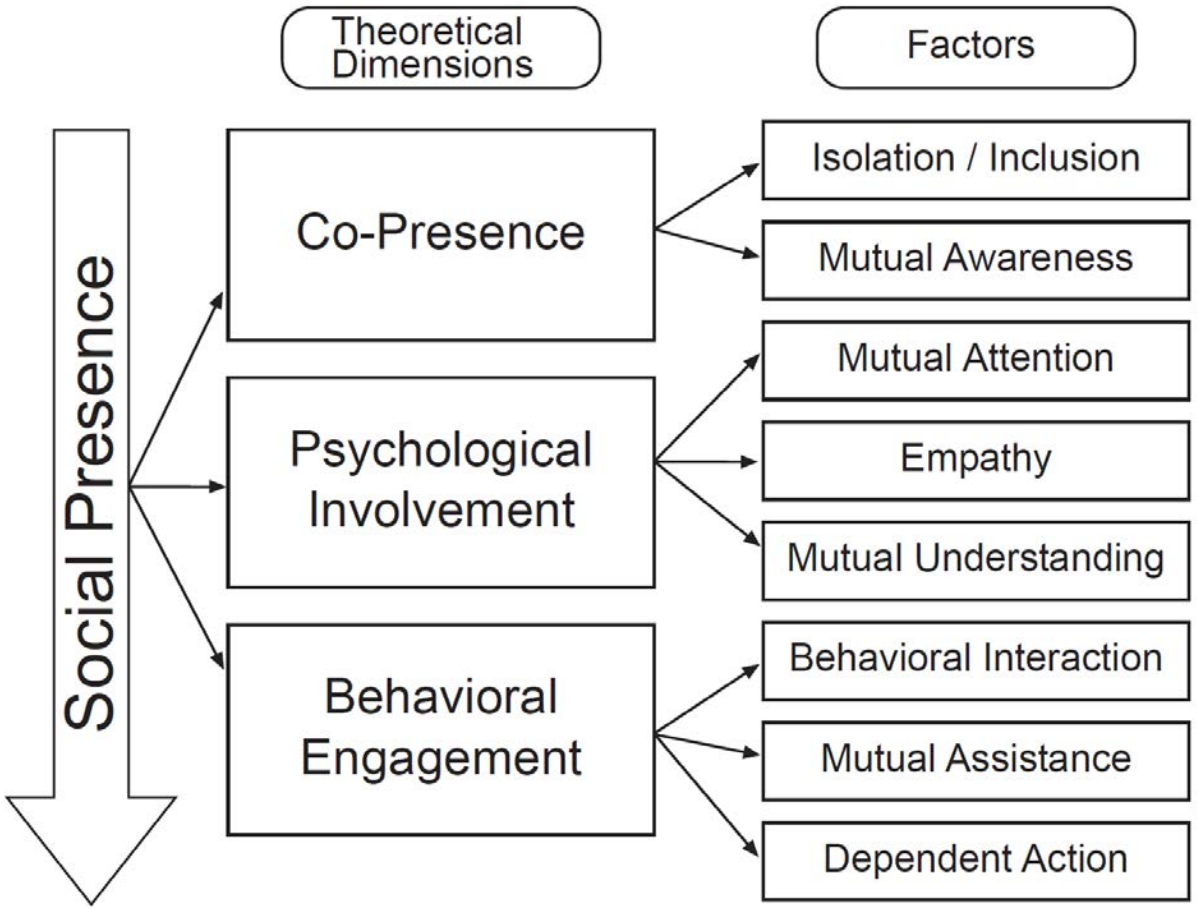
THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

VICTORIA UNIVERSITY WELLINGTON
TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

University of South Australia

Social and Co-Presence

Social Presence – Co-Presence



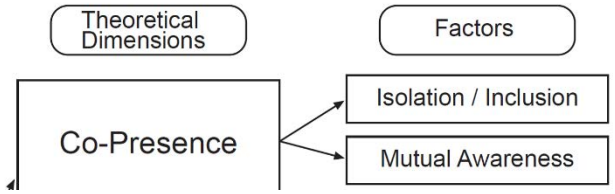
Biocca, F., Harms, C. and Gregg, J.: 2001, The networked minds measure of social presence: Pilot test of the factor structure and concurrent validity, Presence 2001, 4th international workshop, Philadelphia, PA.

ARIVE

Co-Presence

Isolation/aloneness

- I often felt as if I was all alone.
- I think the other individual often felt alone.



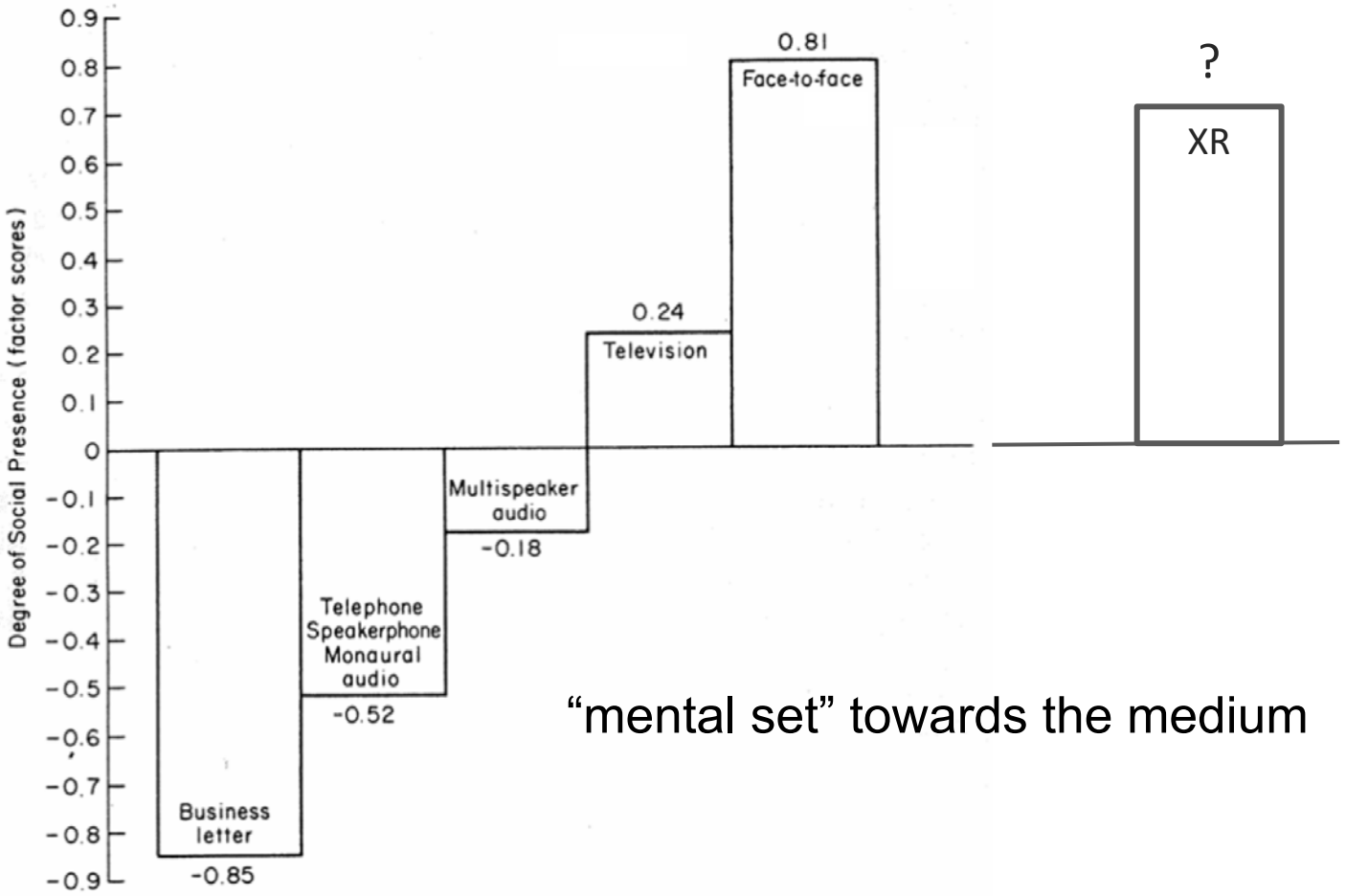
"Note: in this pilot study, items for isolation loaded on the factor for mutual awareness. Researchers believe isolation is a separate factor and will be investigated in future studies."

Mutual Awareness

- I hardly noticed another individual.
- The other individual didn't notice me in the room.
- I was often aware of others in the environment.
- Others were often aware of me in the room.
- I think the other individual often felt alone.
- I often felt as if I was all alone.

Biocca, F., Harms, C. and Gregg, J.: 2001, The networked minds measure of social presence: Pilot test of the factor structure and concurrent validity, Presence 2001, 4th international workshop, Philadelphia, PA.

Social Presence



"mental set" towards the medium

Short, J., Williams, E. and Christie, B.: 1976, The Social Psychology of Telecommunications, Wiley, New York.

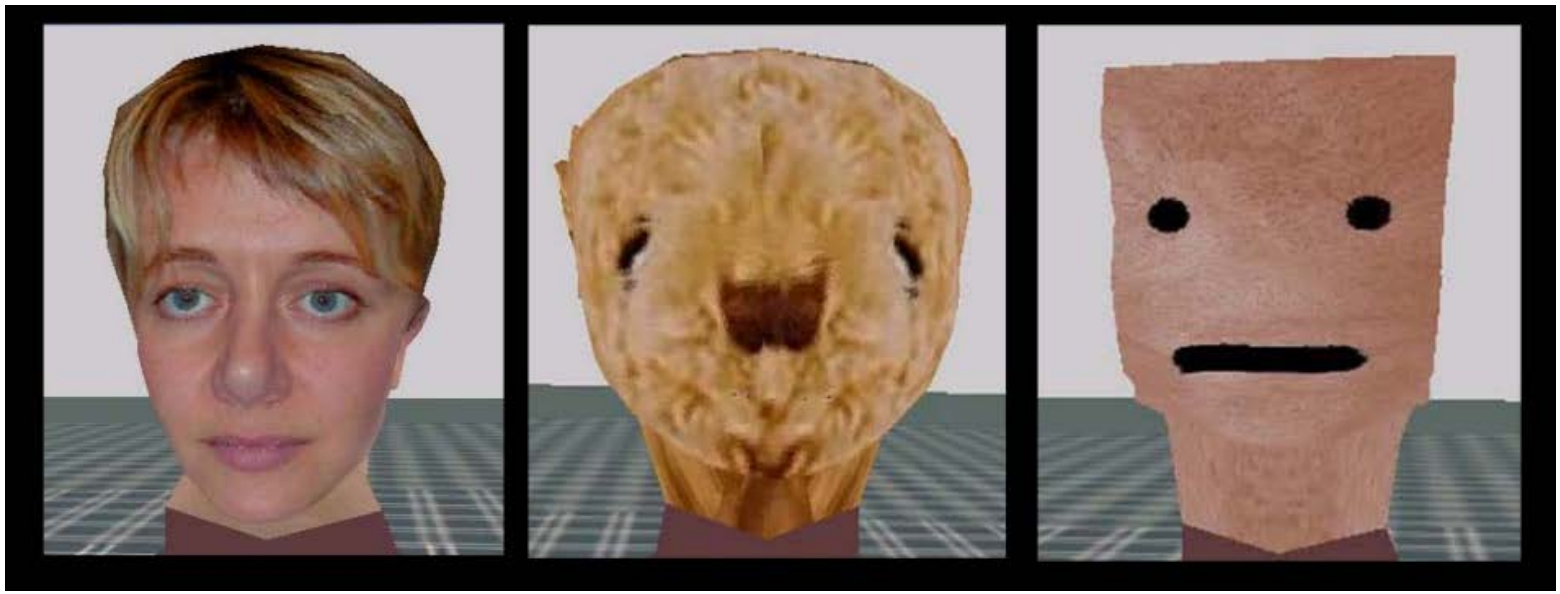
Social Presence Measures

Semantic Differential Technique

cold	☐	☐	☐	☐	☐	warm
insensitive	☐	☐	☐	☐	☐	sensitive
small	☐	☐	☐	☐	☐	large
ugly	☐	☐	☐	☐	☐	beautiful
impersonal	☐	☐	☐	☐	☐	personal
colourless	☐	☐	☐	☐	☐	colourful
closed	☐	☐	☐	☐	☐	open
passive	☐	☐	☐	☐	☐	active
unsociable	☐	☐	☐	☐	☐	sociable

Short, J., Williams, E. and Christie, B.: 1976, The Social Psychology of Telecommunications, Wiley, New York.

Social and Co-Presence



***Copresence* ($\alpha = .71$)**

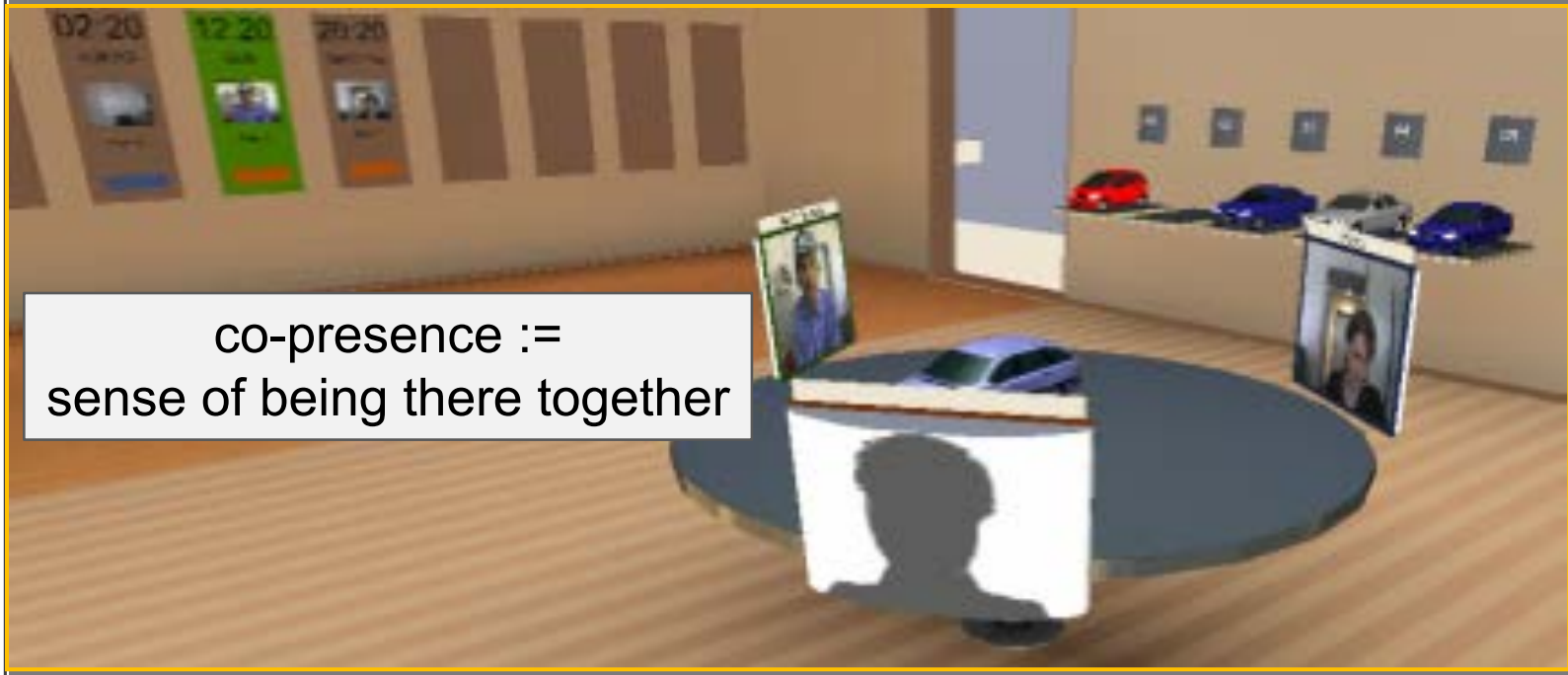
1. Even when the "other" was present, I still felt alone in the virtual room (r).
2. I felt like there was someone else in the room with me.
3. I felt like the "other" was aware of my presence in the room.

Bailenson, J. N., Swinth, K., Hoyt, C., Persky, S., Dimov, A., & Blascovich, J. (2005). The independent and interactive effects of embodied-agent appearance and behavior on self-report, cognitive, and behavioral markers of copresence in immersive virtual environments. Presence: Teleoperators & Virtual Environments, 14(4), 379-393.

ARIVE

Co-Presence [abbreviated]

sense of [spatial] presence :=
sense of being there



co-presence :=
sense of being there together

social presence :=
sense of being together

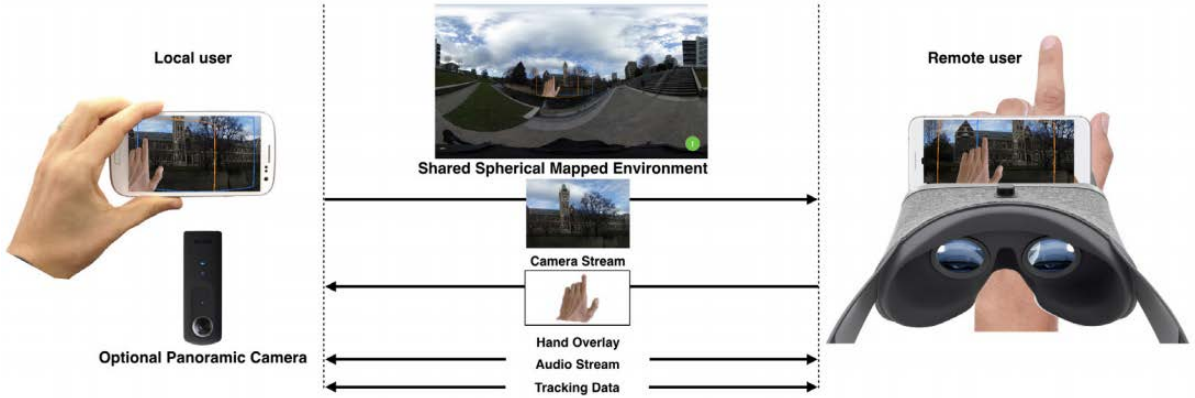
THE UNIVERSITY OF AUCKLAND NEW ZEALAND
UNSW
UC UNIVERSITY OF CANTERBURY Te Whare Wānanga o Waitaha CHRISTCHURCH NEW ZEALAND
MONASH University
UNIVERSITY of OTAGO Te Whare Wānanga o Otāgo NEW ZEALAND
THE UNIVERSITY OF QUEENSLAND AUSTRALIA
VICTORIA UNIVERSITY WELLINGTON
University of South Australia

ARIVE

Telepresence

ARIVE

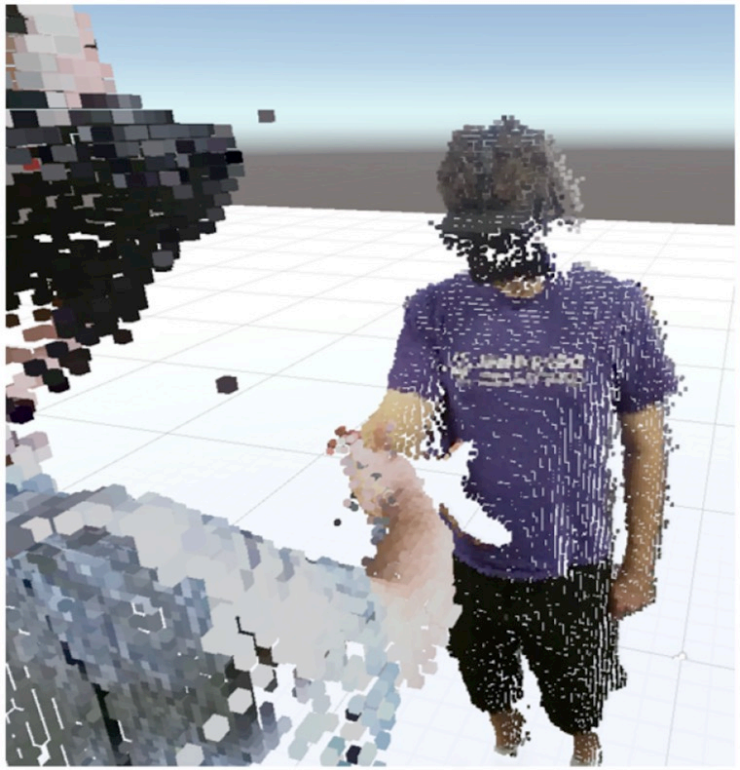
Telepresence

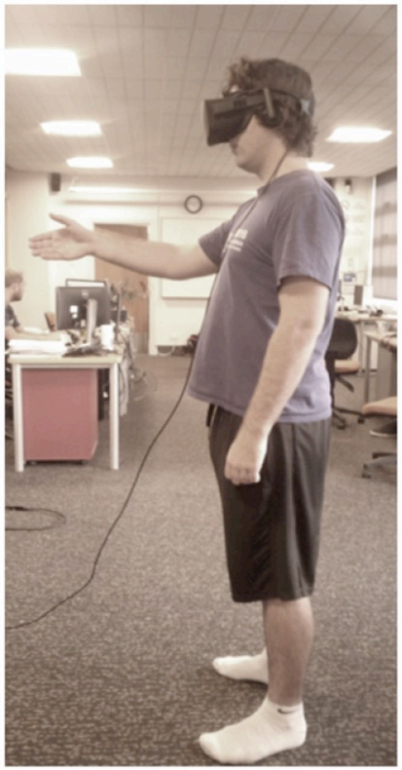


Young, J., Langlotz, T., Cook, M., Mills, S., & Regenbrecht, H. (2019). Immersive telepresence and remote collaboration using mobile and wearable devices. *IEEE transactions on visualization and computer graphics*, *25*(5), 1908-1918.

ARIVE

Tele-Co-presence

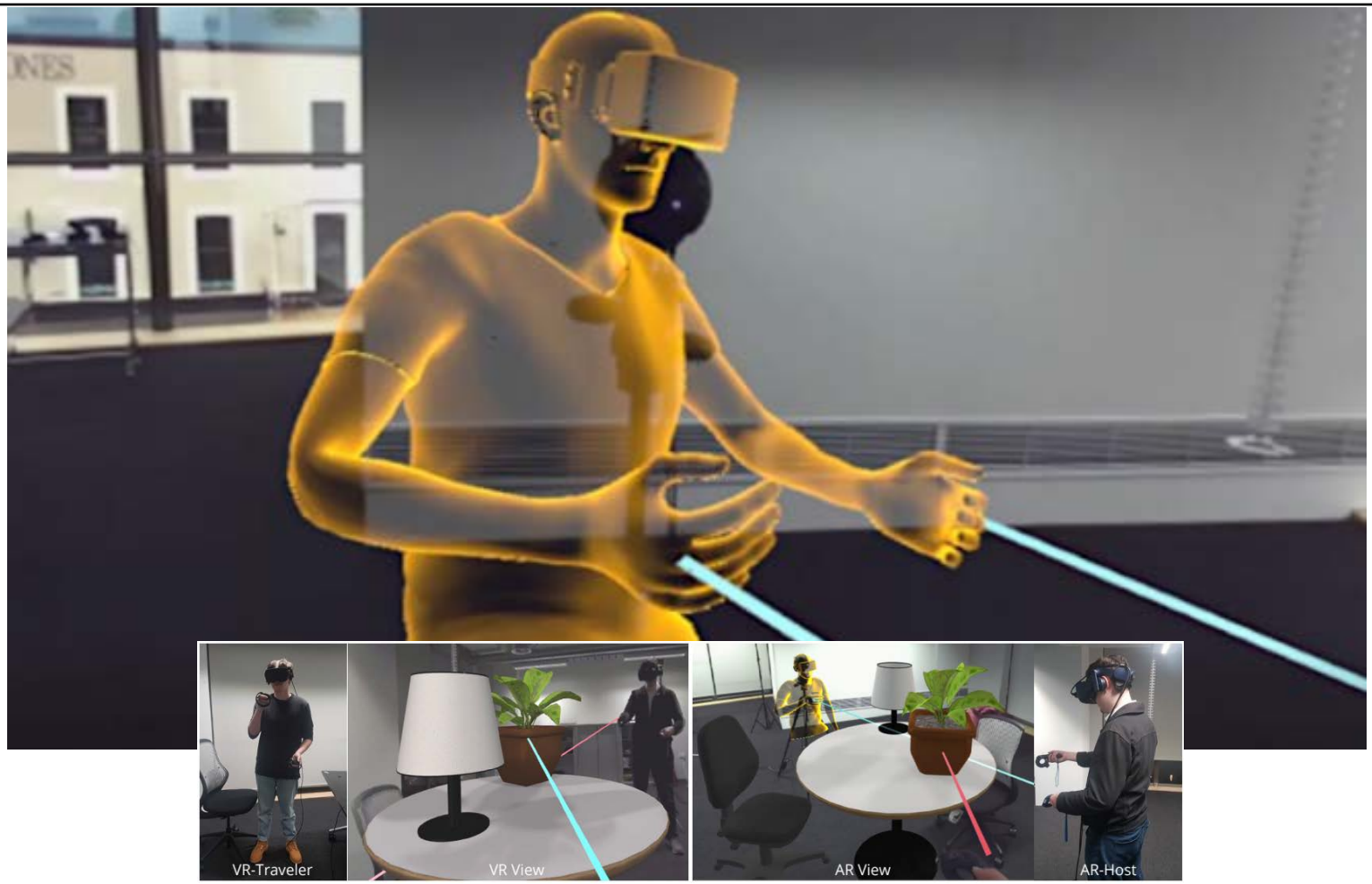




Regenbrecht, H., Park, J. W. N., Ott, C., Mills, S., Cook, M., & Langlotz, T. (2019). Preaching voxels: An alternative approach to mixed reality. *Frontiers in ICT*, *6*, 7.

Park, N. J., & Regenbrecht, H. (2019). Resolutions and Network Latencies Concerning a Voxel Telepresence Experience. Journal of Software Engineering and Applications, 12(05), 171-201.

Telepresence / Tele-Co-presence



Rhee, T., Thompson, S., Medeiros, D., dos Anjos, R., & Chalmers, A. (2020). Augmented Virtual Teleportation for High-Fidelity Telecollaboration. IEEE Transactions on Visualization and Computer Graphics, 26(5), 1923-1933.

Telepresence [abbreviated]

[sense of] telepresence :=
sense of being there [in a remote real environment]

tele-co-presence :=
sense of being there together
[in a remote real environment]

social presence :=
sense of being together

ARIVE

THE UNIVERSITY OF AUCKLAND
Te Whare Wānanga o Tāmaki Makaurau
NEW ZEALAND

UNSW
THE UNIVERSITY OF NEW SOUTH WALES

UC
UNIVERSITY OF CANTERBURY
Te Whare Wānanga o Waitaha
CHRISTCHURCH NEW ZEALAND

MONASH University

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

VICTORIA UNIVERSITY WELLINGTON
TE WHARE WĀNANGA O TE ŪPOKO O TE IKA A MĀUI

University of South Australia

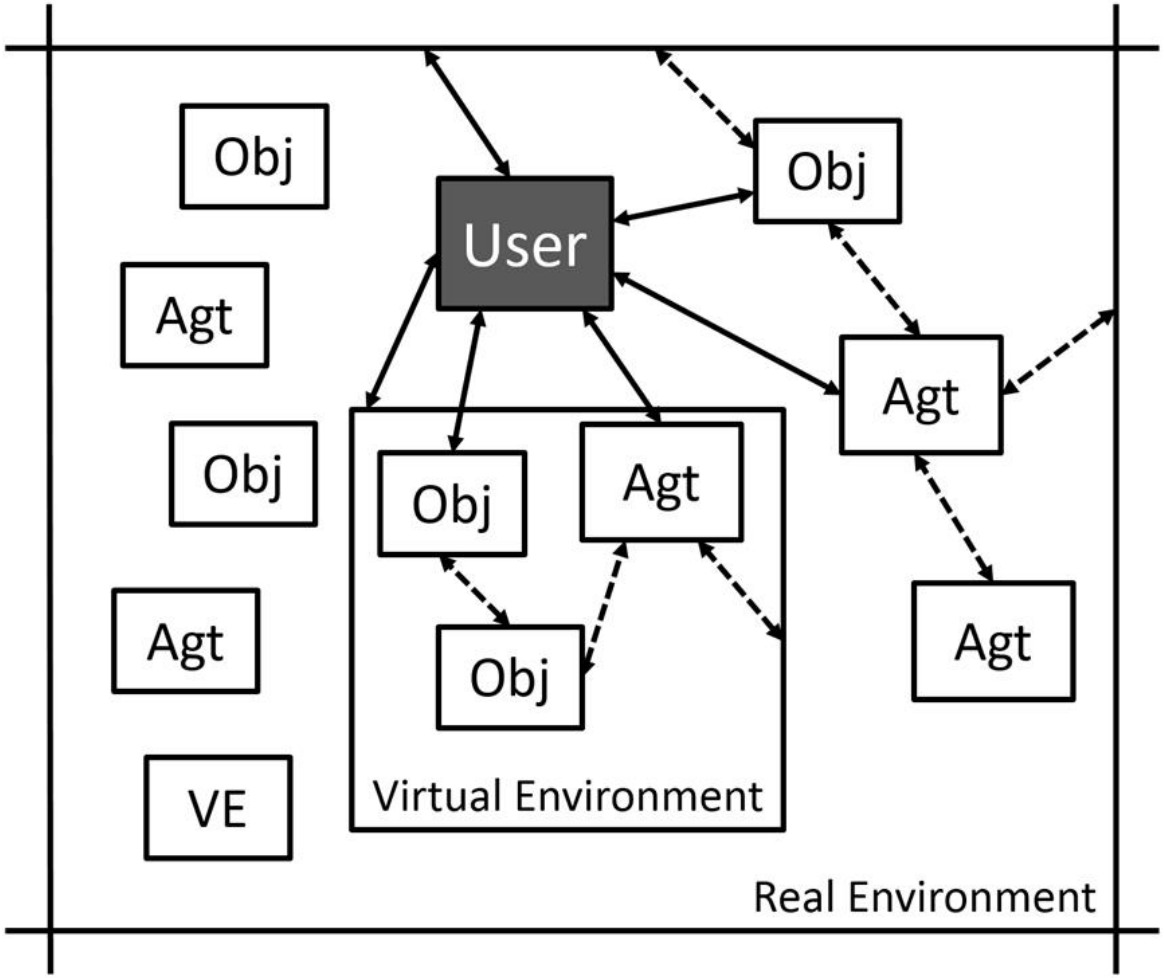
Mixed Reality Presence

ARIVE

Mixed Reality Experience

Collins, J., Regenbrecht, H., & Langlotz, T. (2017). Visual coherence in mixed reality: A systematic enquiry. Presence: Teleoperators and Virtual Environments, 26(1), 16-41.

Mixed Reality Experience



Regenbrecht, H., Botella, C., Baños, R., & Schubert, T. (2017). Mixed Reality Experience Questionnaire (MREQ)—Reference. Technical Report. University of Otago.

ARIVE

AR Presence

	Component		
	1	2	3
P3 Was watching the virtual objects just as natural as watching the real world?	.746	.292	
P2 Did you have the impression that the virtual objects belonged to the real object (dinosaur skull), or did they seem separate from it?	-.745		.228
P4 Did you have the impression that you could have touched and grasped the virtual objects?	.686	.346	-.126
P5 Did the virtual objects appear to be (visualized) on a screen, or did you have the impression that they were located in space?	.187	.828	
P6 Did you have the impression of seeing the virtual objects as merely flat images or as three-dimensional objects?	.271	.801	-.203
P7 Did you pay attention at all to the difference between real and virtual objects?	-.220		.785
P8 Did you have to make an effort to recognize the virtual objects as being three-dimensional?		-.318	.714

Table 1: Component structure matrix

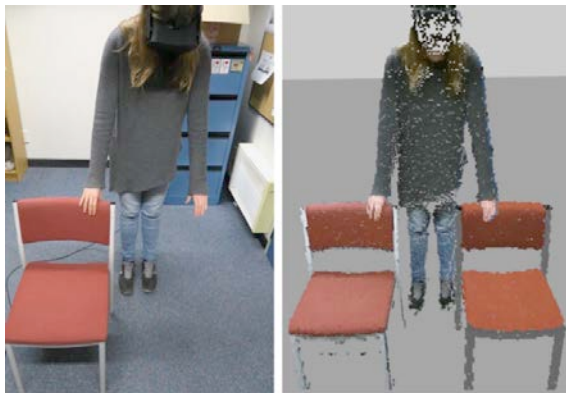
Components:

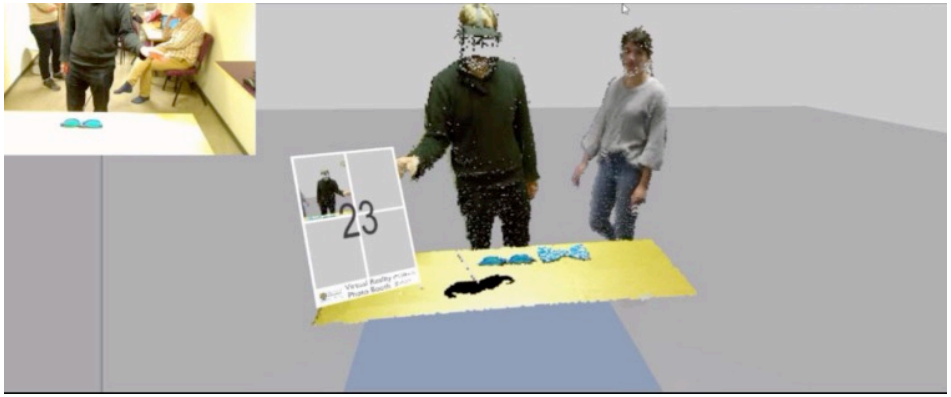
1. realness
2. spatial presence
3. perceptual stress

Regenbrecht, H., & Schubert, T. (2002). Measuring Presence in Augmented Reality Environments: Design and a First Test of a Questionnaire. In Proceedings of the Fifth Annual International Workshop Presence 2002.

ARIVE

MR Presence: some pointers





Schaik, P. V., Turnbull, T., Wersch, A. V., & Drummond, S. (2004). Presence within a mixed reality environment. CyberPsychology & Behavior, 7(5), 540-552.

Wagner, I., Broll, W., Jacucci, G., Kuutii, K., McCall, R., Morrison, A., ... & Terrin, J. J. (2009). On the role of presence in mixed reality. Presence: Teleoperators and Virtual Environments, 18(4), 249-276.

Regenbrecht, H., Meng, K., Reepen, A., Beck, S., & Langlotz, T. (2017, October). Mixed voxel reality: Presence and embodiment in low fidelity, visually coherent, mixed reality environments. In 2017 IEEE International Symposium on Mixed and Augmented Reality (ISMAR) (pp. 90-99). IEEE.

Waterworth, J., & Hoshi, K. (2016). Introduction: Divided Presence in Mixed Reality. In Human-Experiential Design of Presence in Everyday Blended Reality (pp. 3-11). Springer, Cham.

ARIVE

Summary

ARIVE

Summary

- Presence is at the heart of all.
- XR: Designing for presence!
- Immersion ≠ Presence
- {Social | Co- | Tele- | Tele-Co-} Presence

- Measuring Presence:
  Questionnaires are far from being flawless, but still the best we've got.
- More research into alternative measures needed.

- MR Presence concept and measures to be researched.

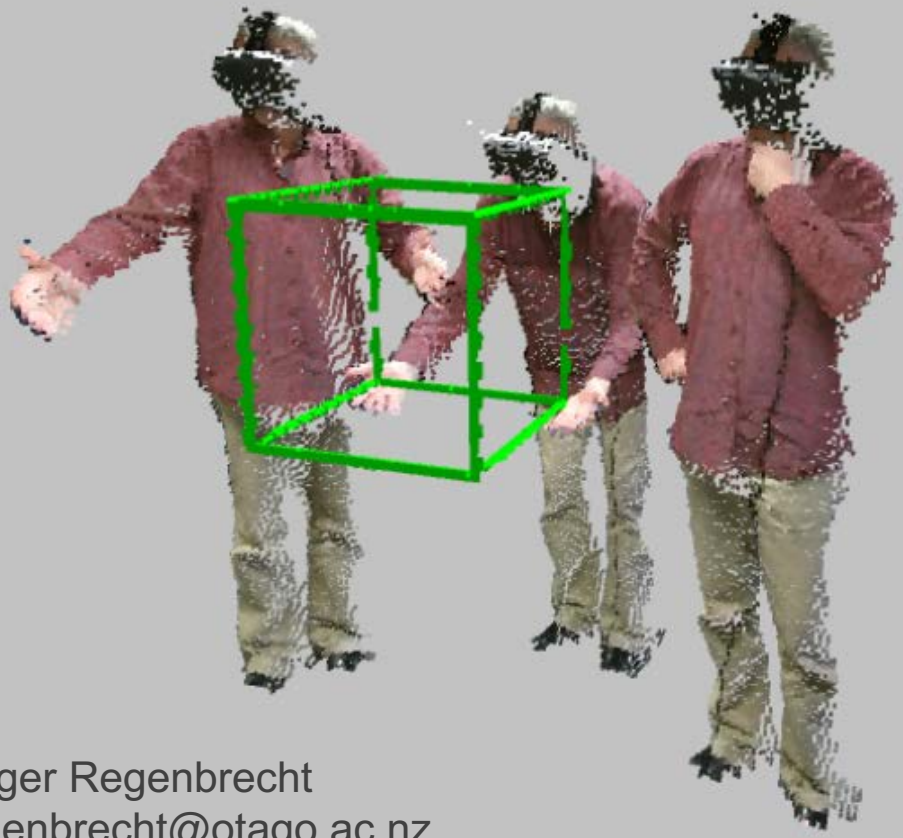
- Don't forget reality! ;)

ARIVE

Reality…What a Concept

ARIVE

Contact (for this lecture)



Holger Regenbrecht
holger.regenbrecht@otago.ac.nz

THE UNIVERSITY OF AUCKLAND
NEW ZEALAND

UNSW

UC UNIVERSITY OF CANTERBURY

MONASH University

UNIVERSITY of OTAGO
Te Whare Wānanga o Otāgo
NEW ZEALAND

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

VICTORIA UNIVERSITY WELLINGTON

University of South Australia