Virtual Reality as embodied interactions

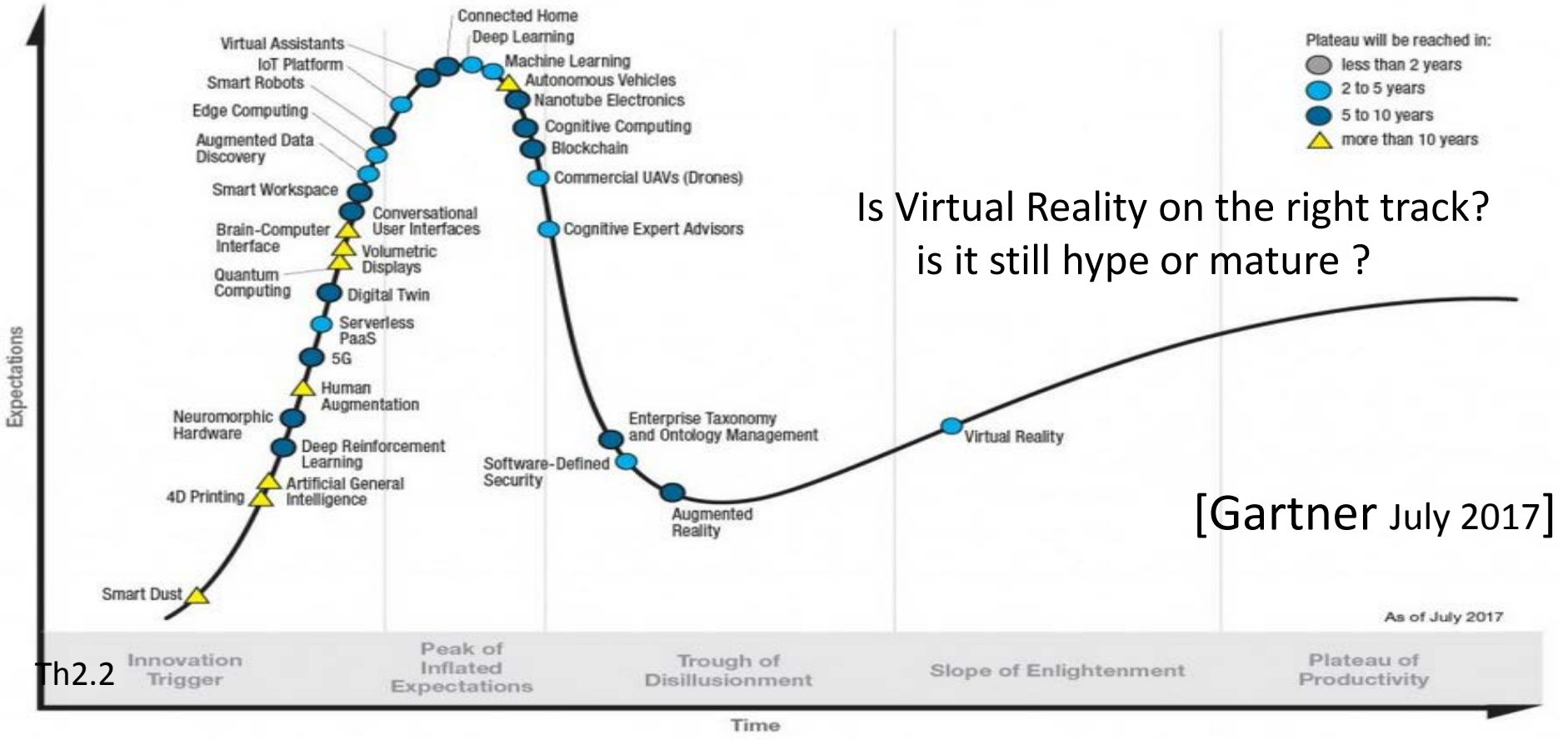
0. Warning: is VR a new Eldorado ?
1. Terminology
2. A historical perspective
3. Conclusion

0. Warning: is VR a new Eldorado ?

July 2014 : Facebook bought Oculus for 2 B$

2016 : Oculus Rift delivered; tough competition with HTC-Vive

2018 : more successful for professionals/games than for families



1. Terminology

Virtual Reality (Jaron Lanier ~1980)

1. Being so in effect or in practice but not in name
2. Nearly so, almost but not quite
3. Computing & internet

actually or physically existing (~tangible), as opposed to imaginary.

[adapted from Chambers Dictionnary & Thesaurus 2008]

1. Terminology (2)

Réalité virtuelle ?

A true oxymoron in french but not so in english

A translation issue : *Virtual* does not exactly correspond to *Virtuel* in french [TRV 2006] .

Vicariant would be more suited as it focuses on « replacing » in Psychology and Physiology

~ similar to *Vicarious* in english

2. A historical perspective: is VR part of HCI ?

Although as old and also addressing Human-Computer-Interaction (HCI), Virtual Reality has had a rather independant evolution as a research & technological field

Why ?

- HCI Goals & Methods
- Towards Embodied interaction
- VR from niche market to research field
- Convergence is back

2.1 HCI Goals & Methods

HCI research is concerned with [O2008]:

improve the interaction between users and computers by making computer systems more user-friendly, usually by improving the usability of the system interface

HCI research goals:

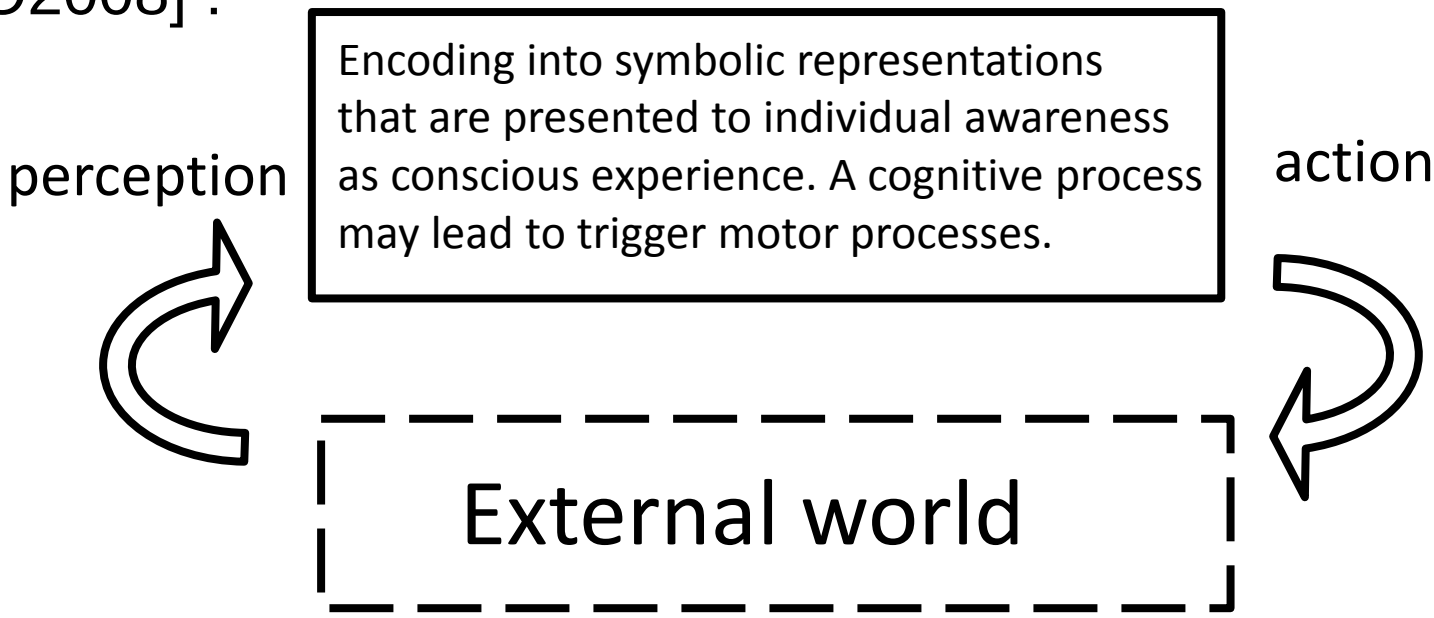
• methods for designing / building / programming computer system interfaces

• methods for evaluating & comparing the usability of interfaces

• developing descriptive theories & predictive models of user interactions

2.2 HCI representationalist perspective

Interaction is largely viewed as mediated by a cognition process operating on abstracted piece of information [O2008] :



perception -> representation -> cognition -> action

- Espitemological root: Descartes (1596-1650) Mind-Body dualism

2.3 Formalizing embodied interactions

The contribution of Phenomenology

- H. Bergson (1859-1941)
- E. Husserl (1859-1938)
- M. Merleau-Ponty (1908-1961)
- M. Heidegger (1889-1976)

-> Reject Cartesian dualism of mind and body
-> The mind cannot be considered without its integration with the body

-> Heidegger has formalized **consciousness** & action [H1927, D2001,O2008]

Key concepts from Heidegger « Being & Time » 1927:

• complementarity of ***ready-to-hand*** & ***present-at-hand*** modes of performing everydays actions

2.4 ready-to-hand & present-at-hand

Heidegger distinguishes two modes of embodied interactions [D2001, O2008]:

Ready-to-hand (handiness): we develop *skillful* use of material of the world and in turn we develop *tacit*, *embodied* knowledge or *know-how* that allows us to cope smoothly with the world around us.

Present-at-hand : is the reflective mode of thinking about the process we are engaged in. Rather mental and internal than physical and active. A second kind of knowledge: *know-that* rather than *know-how*.

2.4 ready-to-hand & present-at-hand (2)

Two examples [D2001]

The hammer: a hammer can be ready-to-hand when used in a standard task by a skilled person; in such a case it *recedes from awareness* as if it became *part of the user's body*. The hammer becomes present-at-hand when it appears to be unusable and has to be examined to be fixed.

The computer mouse [Winograd&Flores1986]: …most of the time I act through the mouse; it is *an extension of my hand* (i.e. in ready-to-hand mode). Sometimes when I reach the end of the mousepad and cannot move the mouse further, my orientation towards the mouse changes. Now I become *conscious* of the mouse mediating my action, precisely because of the fact that it has been interrupted. …The mouse becomes present-at-hand.

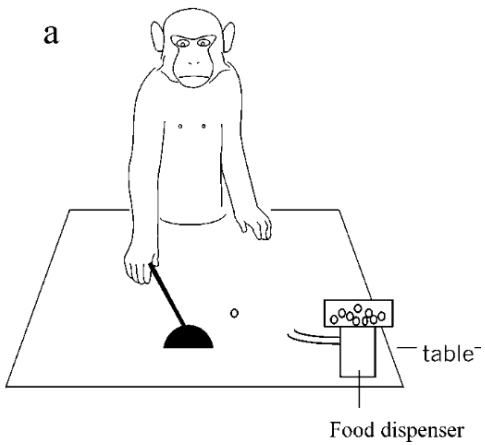
2.4 ready-to-hand & present-at-hand (3)

Most of human activities are spent according to the readiness-to-hand mode (i.e. tool use) similar to a subconscious autopilot mode.

Supported by findings about brain adaption to the use of tools, perceived as body extensions [O2001]

Very close to the “embodied turn” of IA, especially in Robotics [P2006].

On the other hand, human creativity emerges through the periods in present-at-hand mode where problems have to be faced and solved.

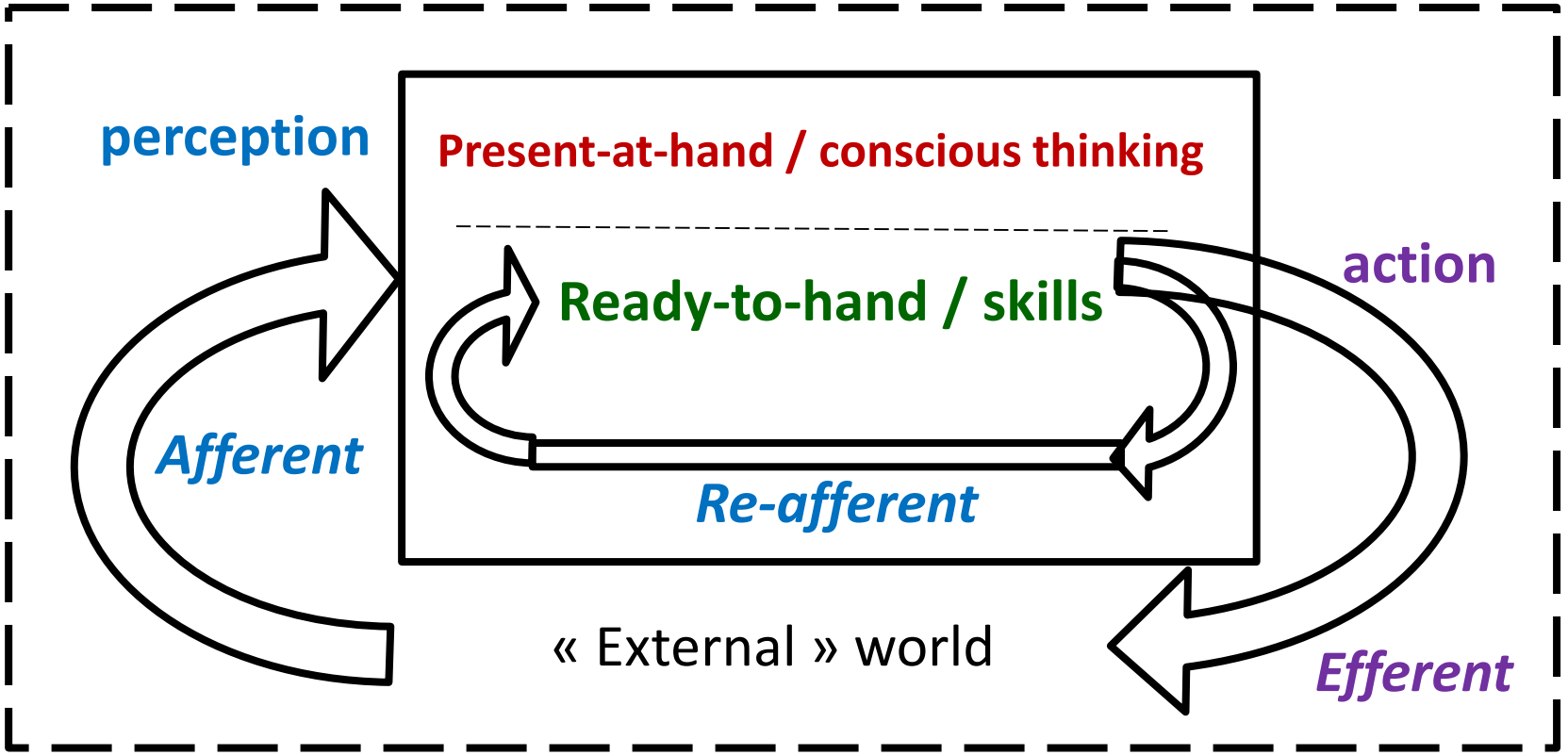


The use of a tool modifies the "body image" in the brain [O2001] [F2007]

This can be related to the concepts from Baldwin [1861-1934] and Piaget [1896-1980] on **learning** about the integration of a *new object or idea* through:
Assimilation (an equivalence is found within the existing mental structure) or
Accomodation (the mental structure is modified to integrate the new entity).

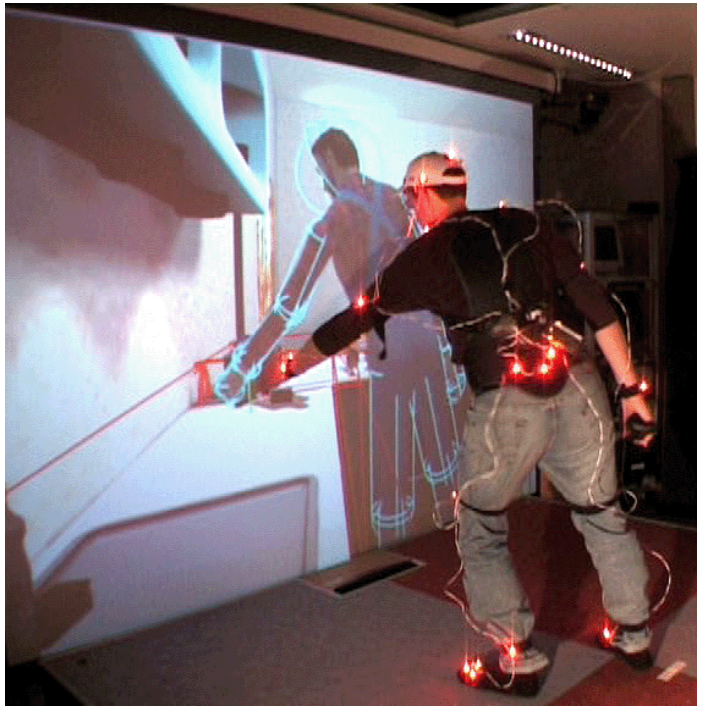
2.5 Embodied interactions in VR

VR heavily relies on body involvement, hence taking advantage of both modes, with the potential advantage of the intuitive nature of the ready-to-hand mode.



Embodied interaction -> Sense of Embodiment (SoE)

- *Do we need a body in VR ?*
- An active field of research structured into:
  - ***sense of body ownership***
    - the avatar body is the source of my experienced sensations
  - ***sense of agency***
    - the avatar body moves according to my will
  - ***sense of self-location***
    - My spatial location coincide with the avatar body location [first person viewpoint vs third person viewpoint]



2.6 VR initial niche market : training

The first VR application were motivated by the high risks and costs of training military/civil pilots.

It is critical to master low-level sensory-motor coordinated skills in addition to high-level symbolic thinking.

Initial core business: flight & driving simulators (plane, tank, train, truck, car, bus, helicopter, etc..)

Main R&D focus : control of complex mechanical systems as closely as the training target.

Niche market due to very expensive training devices: military, aviation

Ex: Electromechanical training

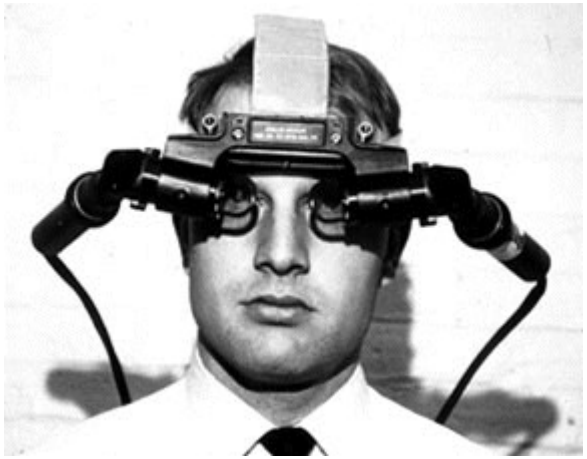
Th2.15 The Link trainer for training pilots in pre-computers era

2.7 VR Research highlights

Ivan Sutherland (1967):
first (heavy) Head-Mounted Display
developed during his PhD in MIT

"A display connected to a digital computer gives us a chance to gain familiarity with concepts not realizable in the physical world. It is a looking glass into a mathematical wonderland."

"The ultimate display would, of course, be a room within which the computer can control the existence of matter. A chair displayed in such a room would be good enough to sit in. Handcuffs displayed in such a room would be confining, and a bullet displayed in such a room would be fatal." (1965). [W]



2.8 Interactive computer artwork highlights

Miron W. Krueger: 60-70-80-90
- Advocate of non-invasive unencumbered interactions with large screen.

Introduced the expression "Artificial Reality" to describe his work. Led to a book in 1983, republished in 1991.

Key piece: Videoplace

http://www.youtube.com/watch?v=dmmxVA5xhuo

2.9 VR as a research field emerged in the 80s

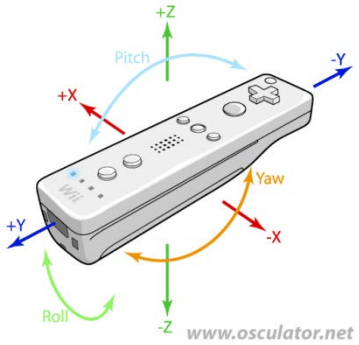
Required heavy hardware investments for ensuring the real-time display of simulated perceptual stimuli (visual, audio, haptic,…) :

- Silicon Graphics
- Evans & Sutherland
- VPL (Jaron Lanier) : dataglove, head-mounted display, sound rendering system,
- Immersion technologies: magnetic trackers…

2.10 Convergence of VR and HCI is back

Still cumbersome and expensive hardware in specific training fields
But:

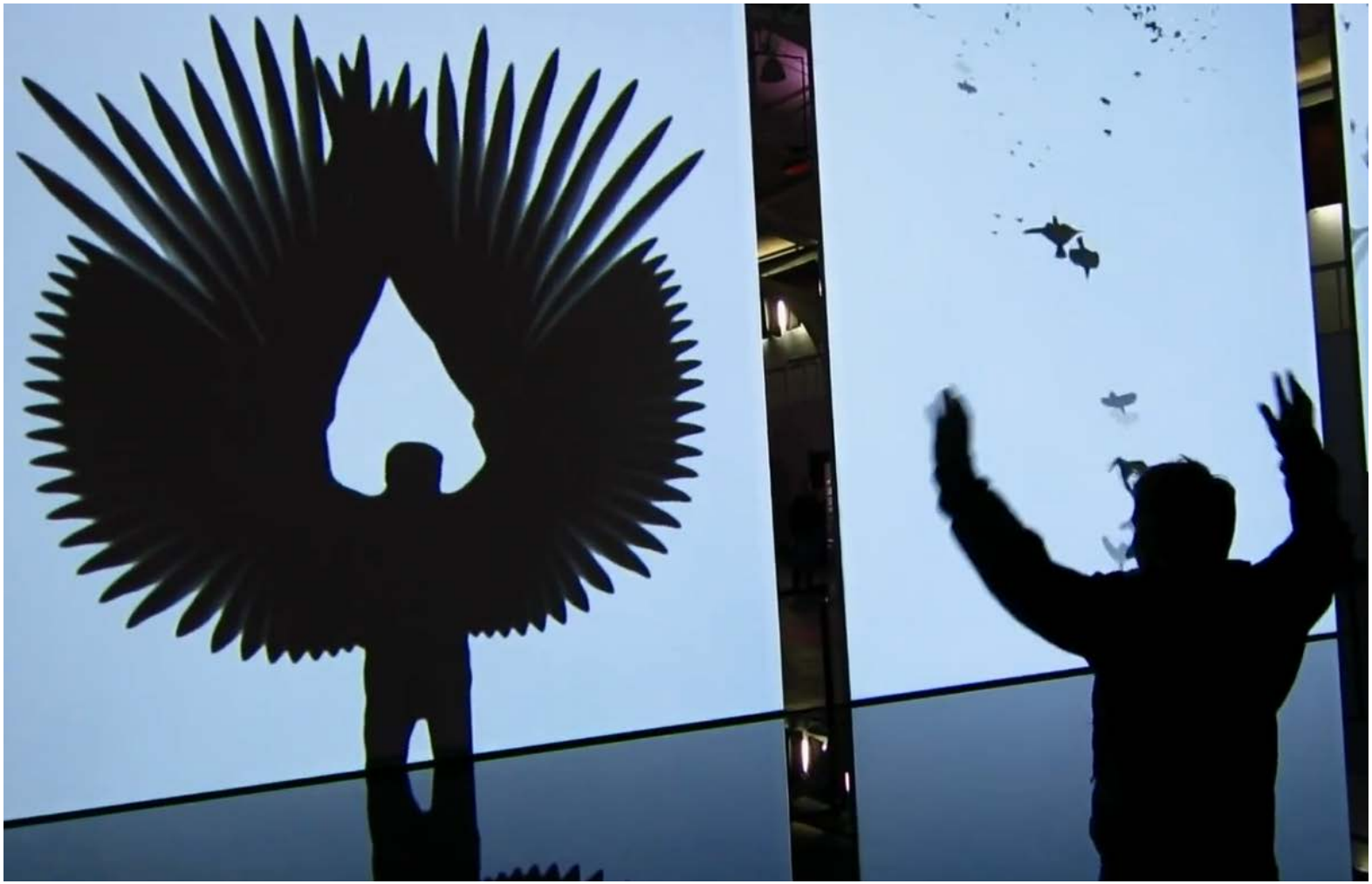
- The PC & GPU revolution provides virtually anybody the same display power as M$ projects from the early 2000.



- The Wii, the Kinect2, the new wave of HMDs and more and more ubiquitous interaction/projection systems open new avenues for full-body immersive interactions

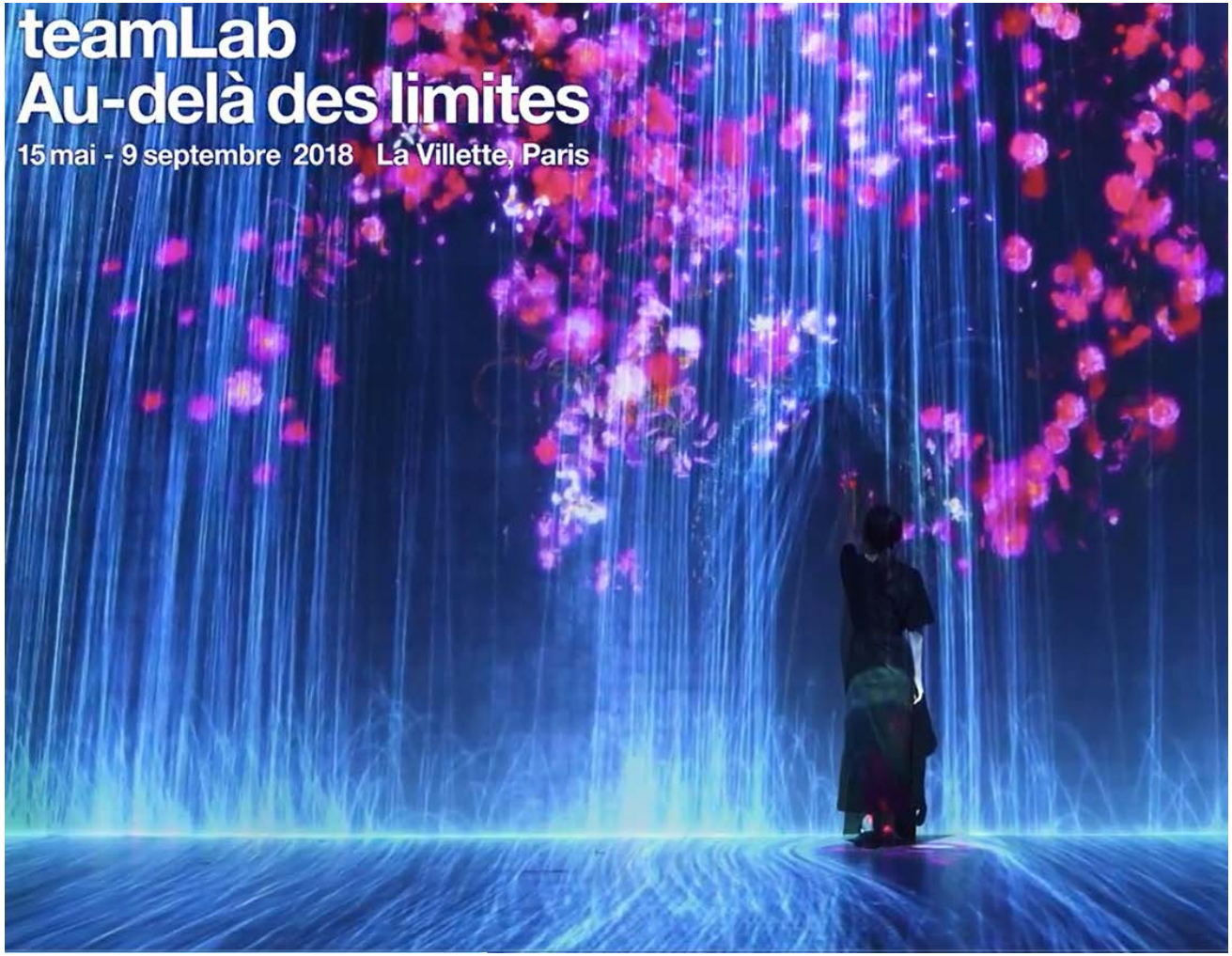
- The potential of mass market applications will require sound evaluation methodologies, as already done in HCI.

2.11 A few recent examples



Th2.20 Non-invasive interaction: Chris Milk The treachery of sancturary 2012

2.11 A few recent examples (2)



Non-invasive interaction: Teamlab in La Villette Paris 2018

2.11 A few recent examples (3)

Th2.22 Berescuer training demo for cardiac re-animation 2018 (with HMD)

3 Conclusion

Virtual Reality was first dedicated to the ***training of deep motor skills*****,** that mostly bypasses the traditionnal cognitive process level addressed in HCI.

Such embodied skills involve ***much faster perception-action loops compared to cognition***. When fully mastered they are usually performed "automatically" without involving the cognitive layer.

Recently applications have greatly benefited from the mass market of games and associated interaction devices, e.g. rehabilitation, curing phobia, training etc...

One of the 14 engineering challenge of the XXI century : http://engineeringchallenges.org/cms/8996/9140.aspx

Next week: what are the conditions for producing a convincing virtual reality ?

[References]

[D2001] Dourish, P.: Where the action is. MIT Press (2001)

[F2007] Frith, C.: Making up the Mind, Blackwell publishing, 2007

[H1927] Heidegger, M.: Being and Time, John Macquarrie and Edward Robinson, translated in English in 1962, New York: Harper and Row (1962)

[K2012] K. Kilteni, R. Groten, M. Slater, The Sense of Embodiment in VR, Presence 21, Fall 2012

[NAE 2008] National Academy of Engineering, USA, "Enhance Virtual Reality"

- http://engineeringchallenges.org/cms/8996/9140.aspx

[O2001] Shigeru Obayashi, Tetsuya Suhara, Koichi Kawabe, Takashi Okauchi, Jun Maeda, Yoshihide Akine, Hirotaka Onoe, Atsushi Iriki, Functional Brain Mapping of Monkey Tool Use, NeuroImage, Volume 14, Issue 4, October 2001, Pages 853-861

[O2008] O'Neill S.: Interactive Media: The Semiotics of Embodied interaction, Springer 2008

[Piaget] http://www.ph-ludwigsburg.de/html/2b-frnz-s-01/overmann/glossaire/accomodationetassimilation.html

[P2006] Rolf Pfeifer and Josh C. Bongard, How the Body Shapes the Way We Think, A New View of Intelligence, MIT Press 2006

[TRV 2006] Traité de Réalité Virtuelle, Ed. P. Fuch, vol1, chap1,Eds A. Berthoz & J.L. Vercher

[W] http://en.wikipedia.org/wiki/Ivan_Sutherland