SIMULATION TOOLS BASED ON VIRTUAL REALITY TECHNOLOGIES

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Plan

- **Introduction**

  Simulation

  Virtual Reality

- **“A virtual reality-based tool to investigate spatial planning”**

  Paper by Déborah A. FOLOPPE, Paul RICHARD, Philippe ALLAIN

- **“Comparing four interaction techniques on a simple structured navigation task using a Head-Mounted Display”**

  Paper by Déborah A. FOLOPPE, Jules MACAIRE, Paul RICHARD

INTRODUCTION

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What is simulation ?

Process of simulating something, or Result of simulating it.

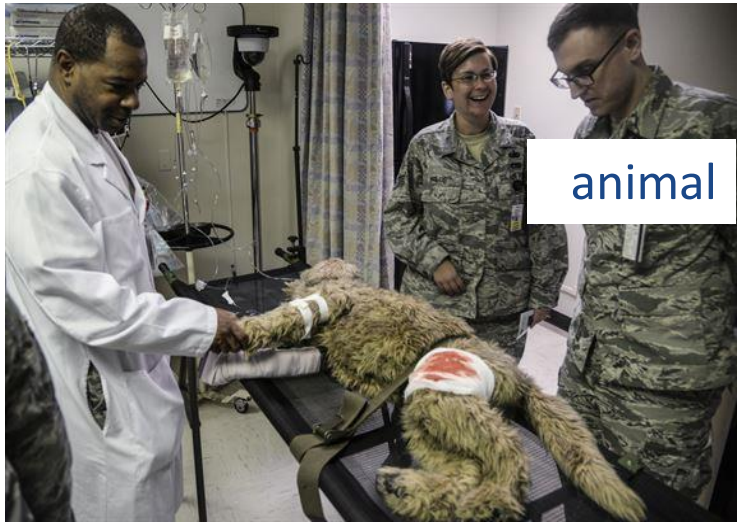
Simulation is the imitation, in some aspects, of a process of interest, on the basis of a model including parameters and variables, which are the images of the parameters and the variables from the process of interest.

Process of interest from various natures: astronomical, biological, social, …

Introduction

Two main kinds of tools

- Physical, mechanical



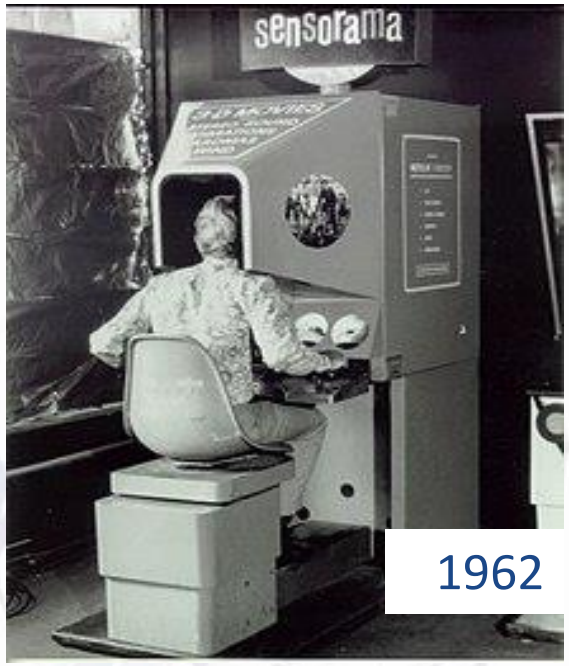
Introduction

- But the most often, simulation are based on softwares, sometimes associated to elements of **analogical** computing. They are especially interesting convenient for the implementation and the control of models related to the focused process.

eg, tools based on virtual reality

VR can imitate realities, by replacing sensory input from real world with computer generated sensations

Vision, Hearing, Touch, even Smell and Taste



1962

Mechanical ancestor of VR

Introduction

A VR based system allows humans (users)
to experiment virtual worlds
and to perform some tasks “in virtuo“
thanks to dedicated devices (pseudo-natural)

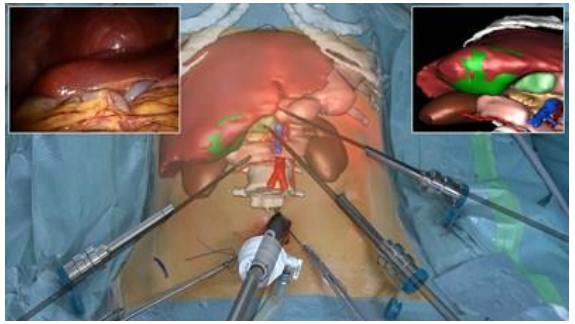
VR

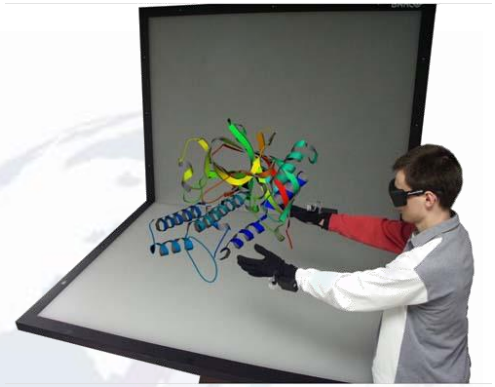
Computer-generated

Multimodal

Interactive

Believable





Introduction

Visualization

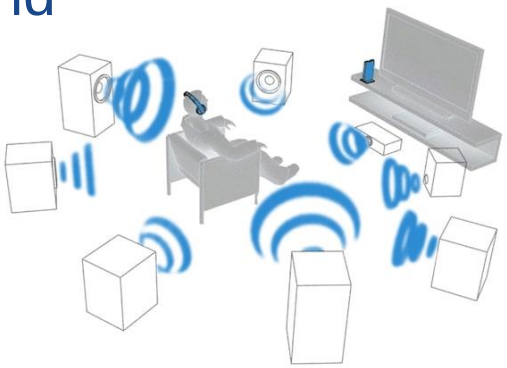
Fully immersive

Large semi-immersive displays

Equipments
C --> H

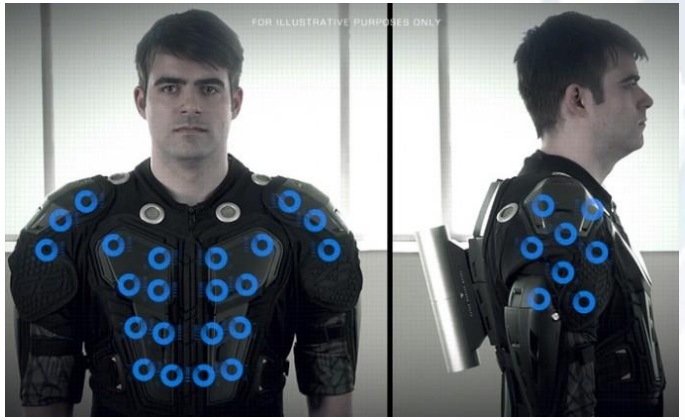
Hearing

3D sound



Force & Touch

Exoskeletons

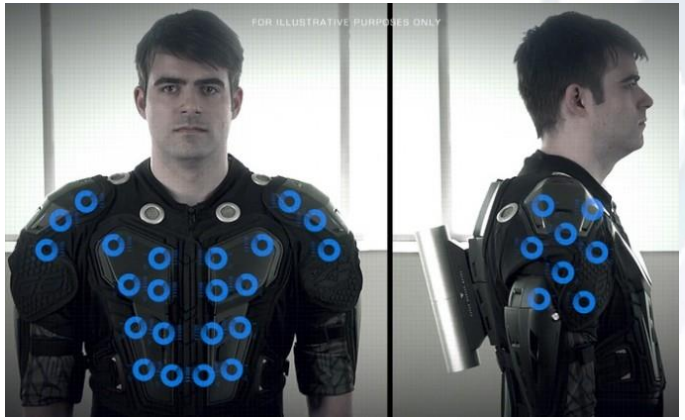


Introduction

Input/Ouput devices

Force & Touch

Exoskeletons



Introduction

Equipments
H --> C

Basic gamepads

Camera based sensors

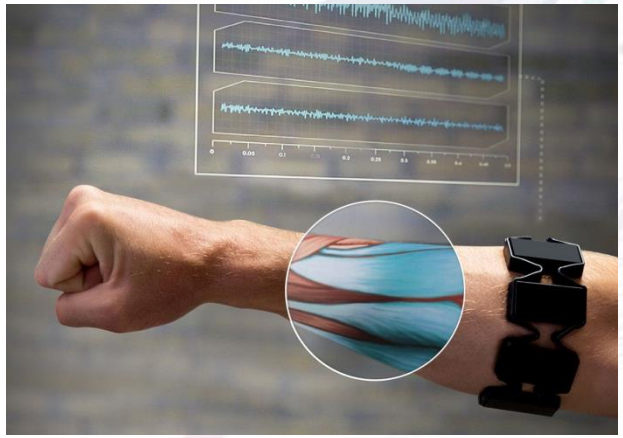
RBGD

IR

Treadmills

EEG +EMG

EMG



Interest of VR for simulation

- VR allows to experiment various scenario and tasks, easily
- Fine control of parameters and variables
- Interactive systems allow data recording and analysis
- People can use VR, even they are unfamiliar with technologies

A VIRTUAL REALITY-BASED TOOL TO INVESTIGATE SPATIAL PLANNING

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A Tool to Investigate Cognition

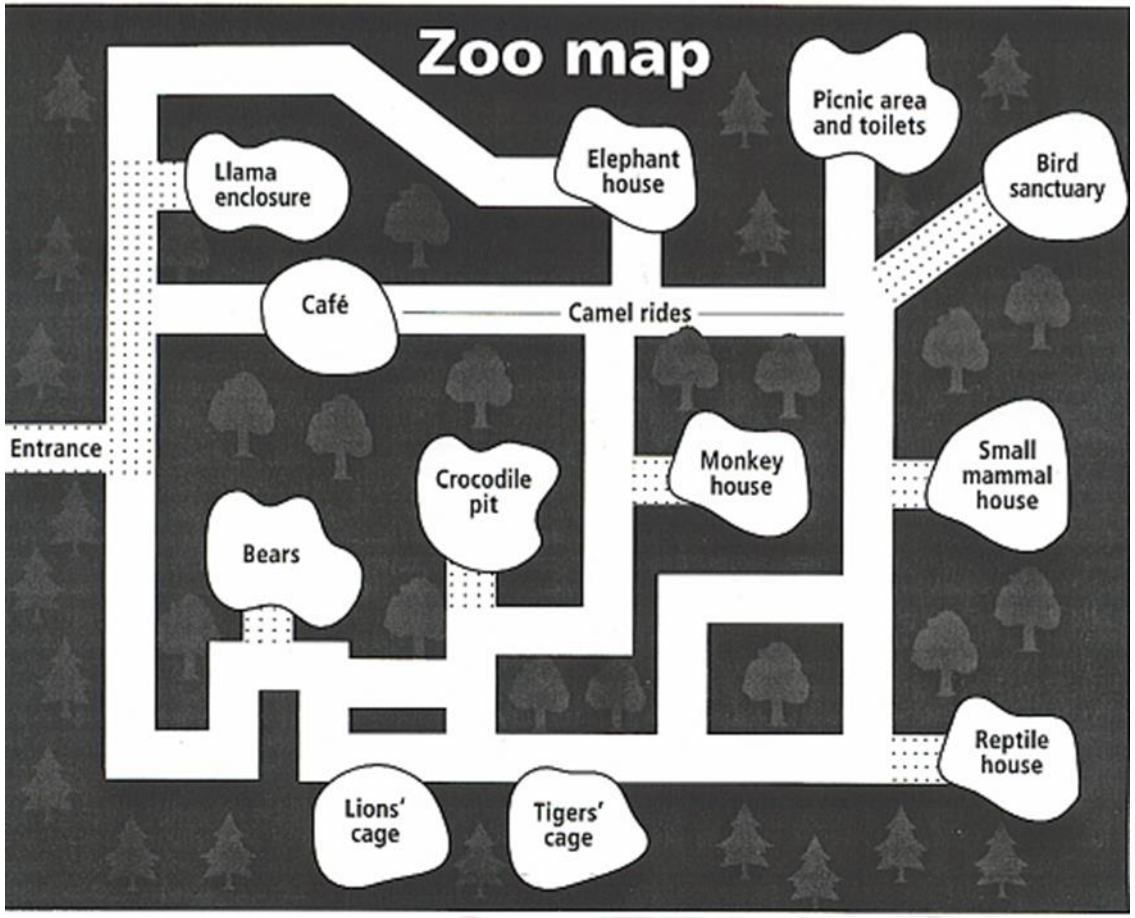
Tools focusing specific abilities

Behavioural Assessment of the Dysexecutive Syndrome (Wilson et al, 1996)

Task from ZMT

Indicate the path to visit designated locations of a zoo, while following certain rules

- First trial = a high demand version of the task, in which the patient must plan in advance the order in which the will be visited (formulation + execution)
- Second = less demand version, in which the order is given (execution)



A Tool to Investigate Cognition

Coordination of these various cognitive components in service of a future goal?

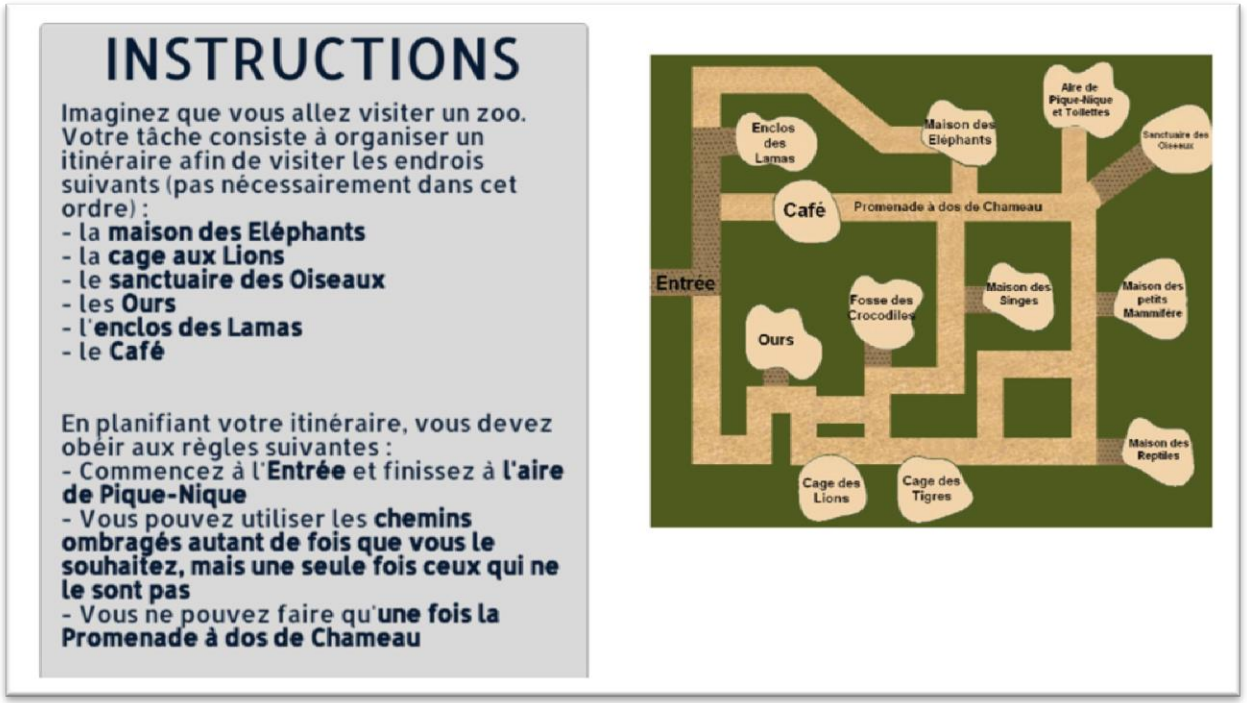
A Virtual Zoo Map Test for a better understanding

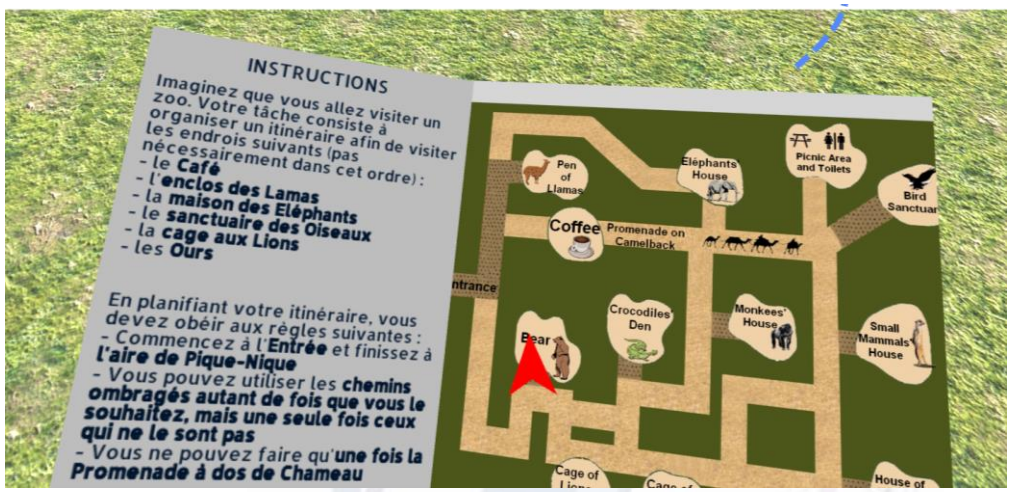
- Cognitive planning
- Plan execution
- Initiation
- Update
- Inhibition

A Tool to Investigate Cognition

Cognitive planning

Initial time for formulation + Instructions sheet consultation





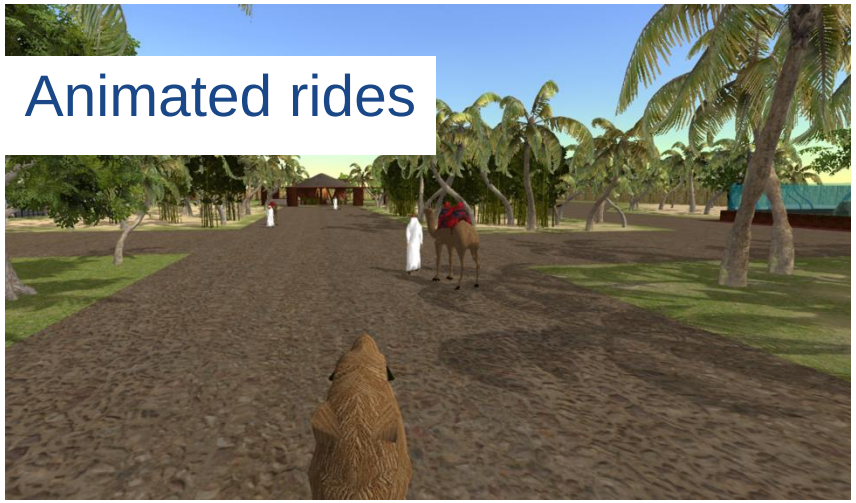
Plan execution

Automatized data recording

- Initiation time
- hesitations
- …

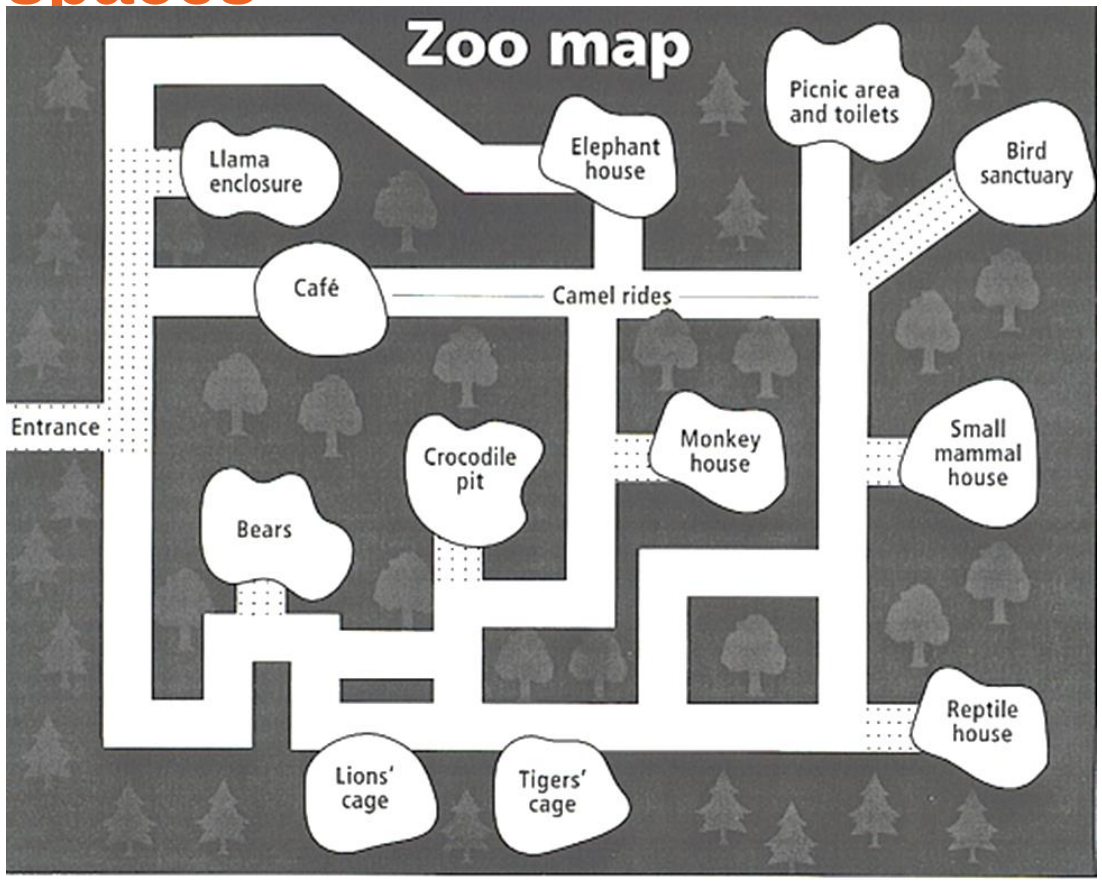
A Tool to Investigate Cognition

Inhibition



A Tool to Investigate Cognition

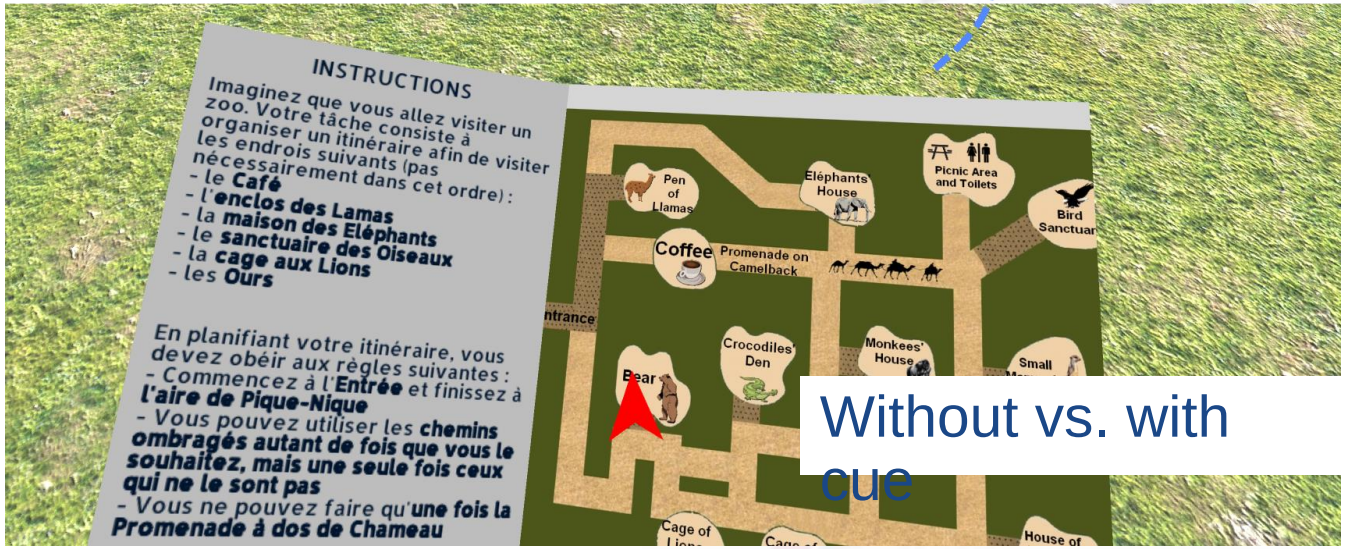
Small spaces vs navigable spaces



A Tool to Investigate Cognition

Update of the spatial position (orientation)

- Visual memory
- Proprioceptive memory

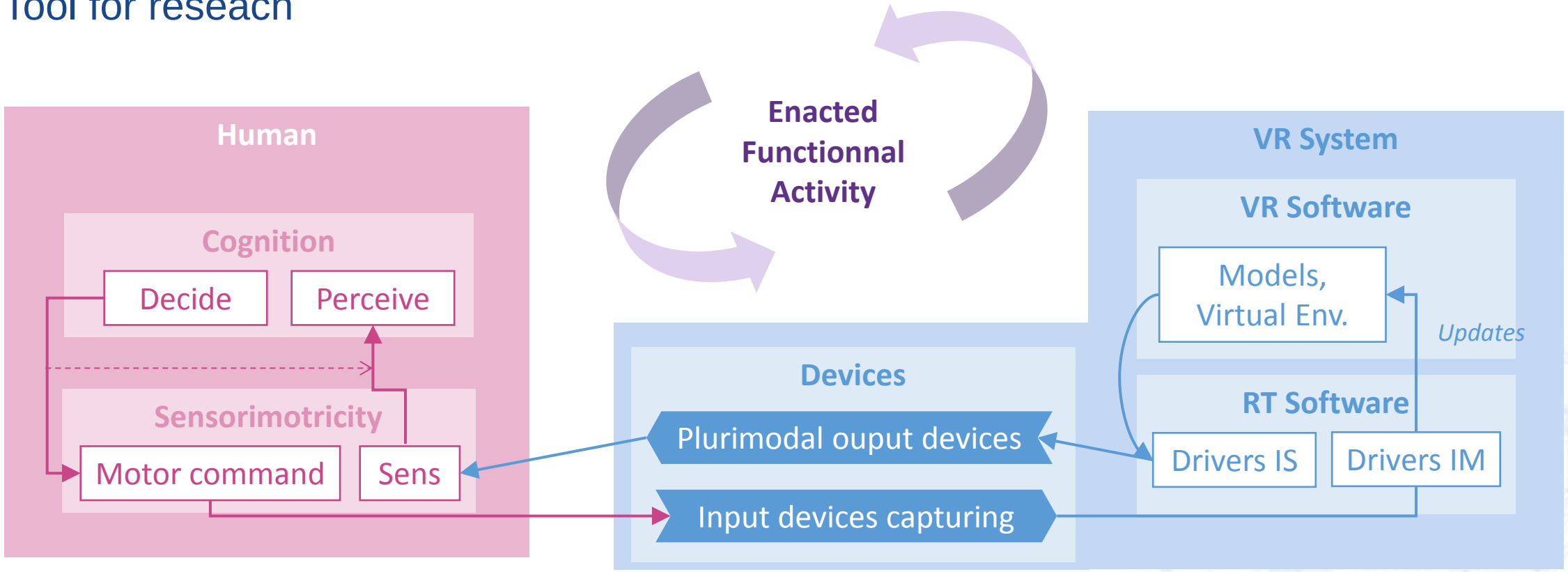


Without vs. with cue

A Tool to Investigate Cognition

Conclusion

Tool for reseach



Update position: interaction?

COMPARING FOUR INTERACTION TECHNIQUES ON A SIMPLE STRUCTURED NAVIGATION TASK USING A HEAD-MOUNTED DISPLAY

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Role of Interaction on Performance

Introduction

Représentation graphique du CyberSphere (University of Warwick)

Marche sur place suspendue (Templeman's Gaiter system, NRL)

Navigation par cyclisme (Hodgins, Georgia Tech)

Tapis unidirectionnel (Sarcos)

Tapis multidirectionnel (Sarcos)

Since the 2010's, many Head-Mounted Display (HMD) are available for immersive VR.

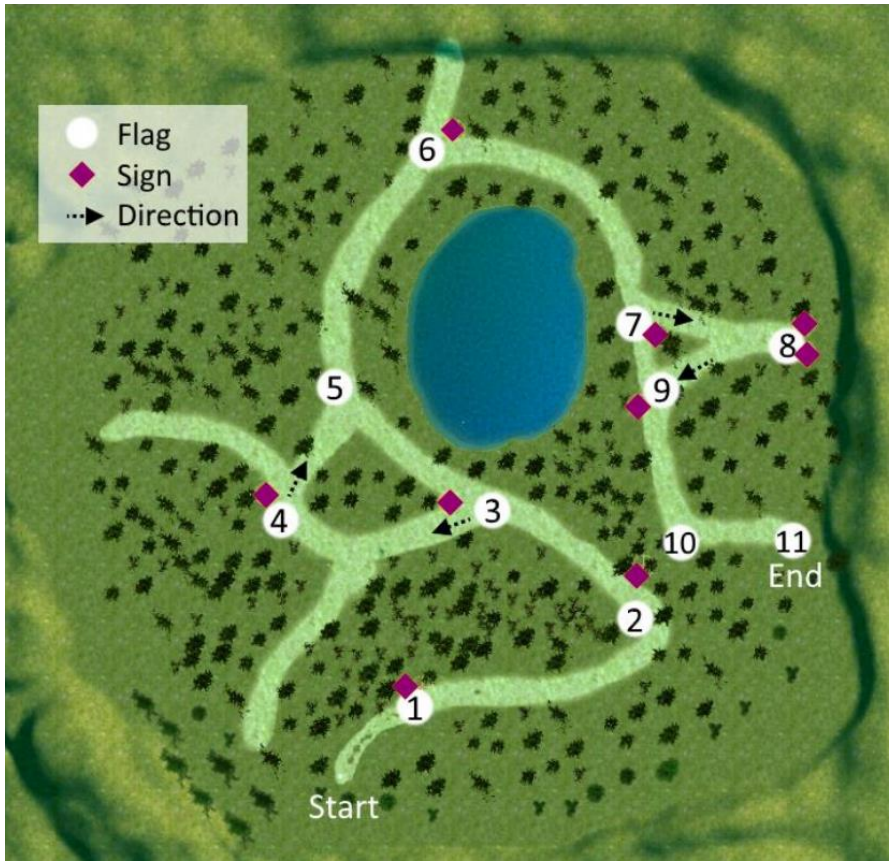
Focus on impact of navigation techniques with the HTC Vive on performance on a simple traveling centered task?

Materials & Method…

Role of Interaction on Performance

Twenty healthy volunteers performed a navigational task

The path was indicated by flags to collect



Each participant performed a session to try each of the 4 conditions to compare navigation techniques:

- Arms Swinging
- Walking-In-Place
- Pointing
- Touchpad

Each participant made 2 sessions to measure an effect of famillirity

Role of Interaction on Performance

Mesures of performance

Completion time (sessions mean)

Distance travelled (sessions mean)

Walking speed (sessions mean)

Improve Distance (Session 2 – Session 1)

Improve Speed (Session 2 – Session 1)

Role of Interaction on Performance

Results

Technique	Completion time
Walking-in-place	-
Arms-swinging	-
Pointing	-
Directional touchpad	+

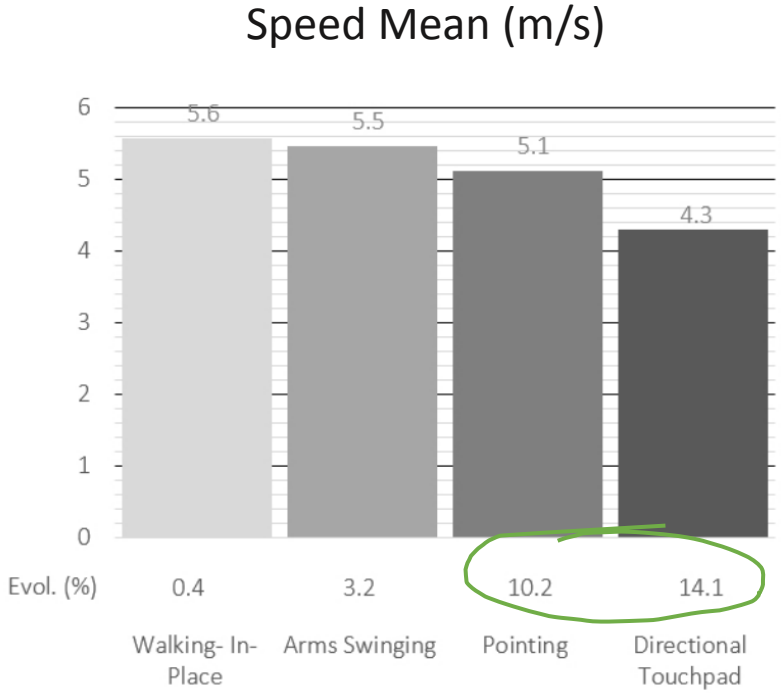
Role of Interaction on Performance

Technique	Completion time	Distance travelled
Walking-in-place	-	+
Arms-swinging	-	+
Pointing	-	--
Directional touchpad	+	-

Role of Interaction on Performance

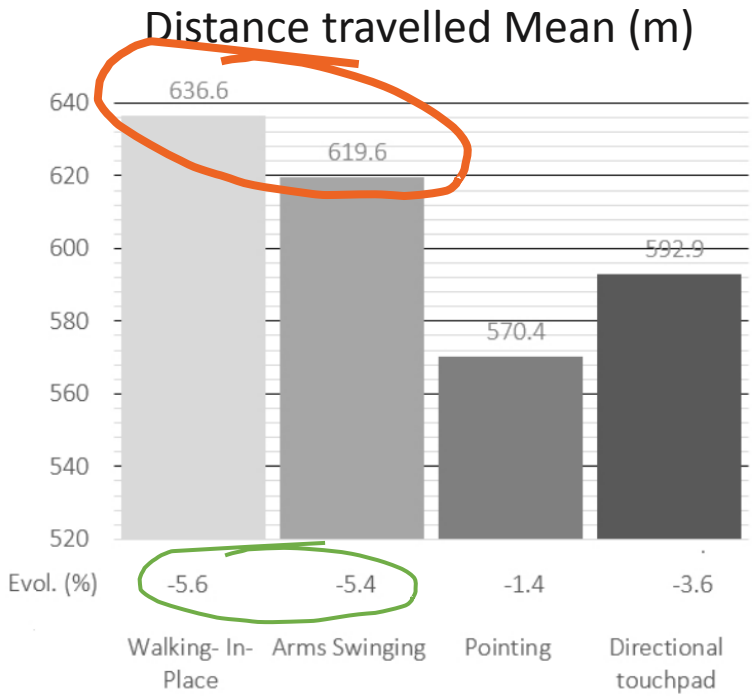
Technique	Completion time	Distance travelled	Walking speed
Walking-in-place	-	+	+
Arms-swinging	-	+	+
Pointing	-	--	-
Directional touchpad	+	-	--

Role of Interaction on Performance



Technique	Completion time	Distance travelled	Walking speed	Improv. Distance	Improv. Speed
Walking-in-place	-	+	+		x
Arms-swinging	-	+	+		x
Pointing	-	--	-	x	+
Directional touchpad	+	-	--	x	++

Role of Interaction on Performance



Technique	Completion time	Distance travelled	Walking speed	Improv. Distance	Improv. Speed
Walking-in-place	-	+	+	-	x
Arms-swinging	-	+	+	-	x
Pointing	-	--	-	x	+
Directional touchpad	+	-	--	x	++

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Conclusion

Artificial techniques are known to be intuitive.

In this study, we observed that, overall, participants varied a few in their ability to complete the task and that the navigation techniques appeared to have little influence on the task completion time.

Repetition of the task may let participants to spend less time to collect the flag because they learn the prescribed path though all conditions and sessions.

The walking-in-place as we implemented could be improved to obtain better performance and comfort to use

THANK FOR YOUR ATTENTION

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