

# Visual Simulation Methods for Environment-Behavior Study

Overview of some previous research applications  
in Ohno Laboratory, Tokyo Institute of Technology

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# **Our simulation system attempted to develop :**

## **1) to present various mode of display**

Static  $\Rightarrow$  Dynamic

Passive  $\Rightarrow$  Active

Focal vision  $\Rightarrow$  Peripheral vision

Only vision  $\Rightarrow$  Multi-modal (+kinesthesia)

## **2) to apply new research subjects**

e.g.: Orientation in a zero gravity environment

## **3) to improve hardware for easier manipulation**

Combination of scale-model (analogue) with  
computer graphics (digital)

# 動的額縁効果

## Effects of Scenes Emerging from the Occluding Edges on Visual Attention and Evaluation of the Landscape

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横浜 Yokohama








	scene I	scene II	scene III
scene			
visual stimuli			
characteristics	many components are scattered over the scene	components are located on both sides of the scene	components are located in the center and on both sides of the scene
components of the scene	trees/old apartments / high-rise buildings	sea/blue sky /high-rise buildings	temple /high-rise building / Ferris wheel

Figure 1 The three outdoor scenes used in the experiment

# <Method>

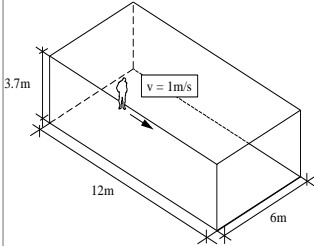
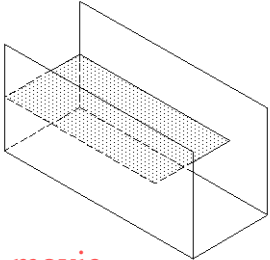
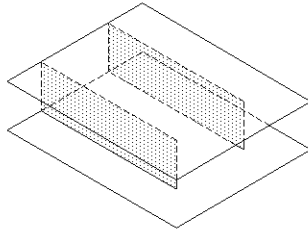
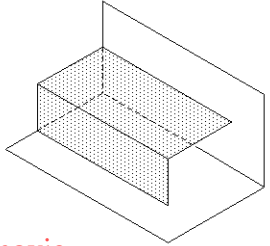
	symmetry type	asymmetry type		
		ceiling type	wall type	ceiling/wall type
spatial form		 <a href="#">movie</a>	 <a href="#">movie</a>	 <a href="#">movie</a>
horizontal dimension of the surfaces	all surfaces have equal length	the ceiling is shorter than the walls	the walls in both sides are shorter than the ceiling	the ceiling and the wall in the right are shorter
movement of the occluding edges	the occluding edges of all sides move together and disappear at the same time	the occluding edge in the top moves faster and disappear in the earlier stage	the occluding edges in the both sides move faster and disappear in the earlier stage	the occluding edges in the top and the right-hand side moves faster and disappear in earlier stage

Figure 2 Four exit spaces used in the experiment

Figure 3 The movement of occluding edges in three asymmetry types of exit space (movie)



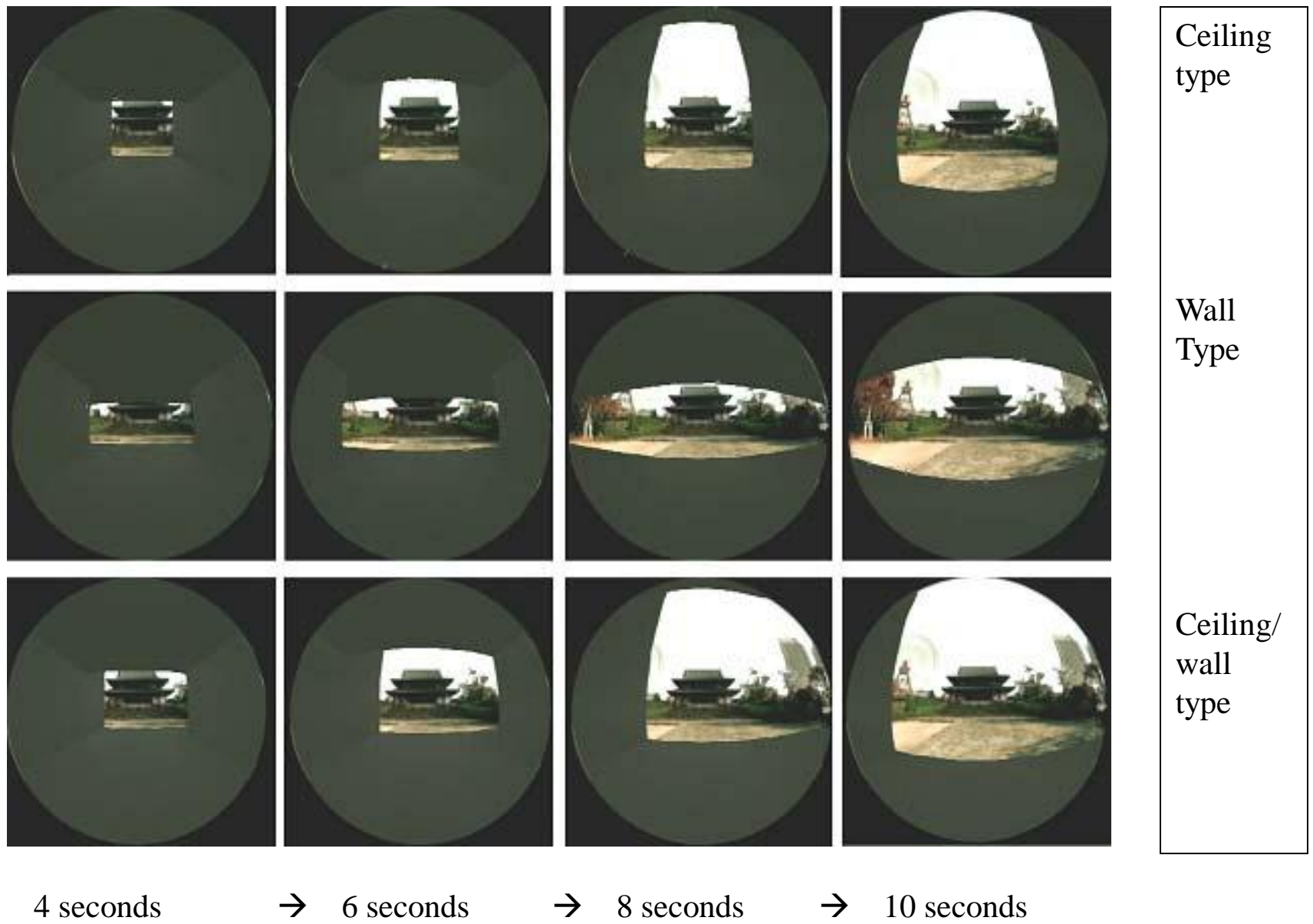


Figure 3 Movement of occluding edges for the three asymmetrical types of exit space  
( scene III )





Figure 4 The orthographic projection screen observed by a subject



Figure 5 The Subject wears eye mark recorder

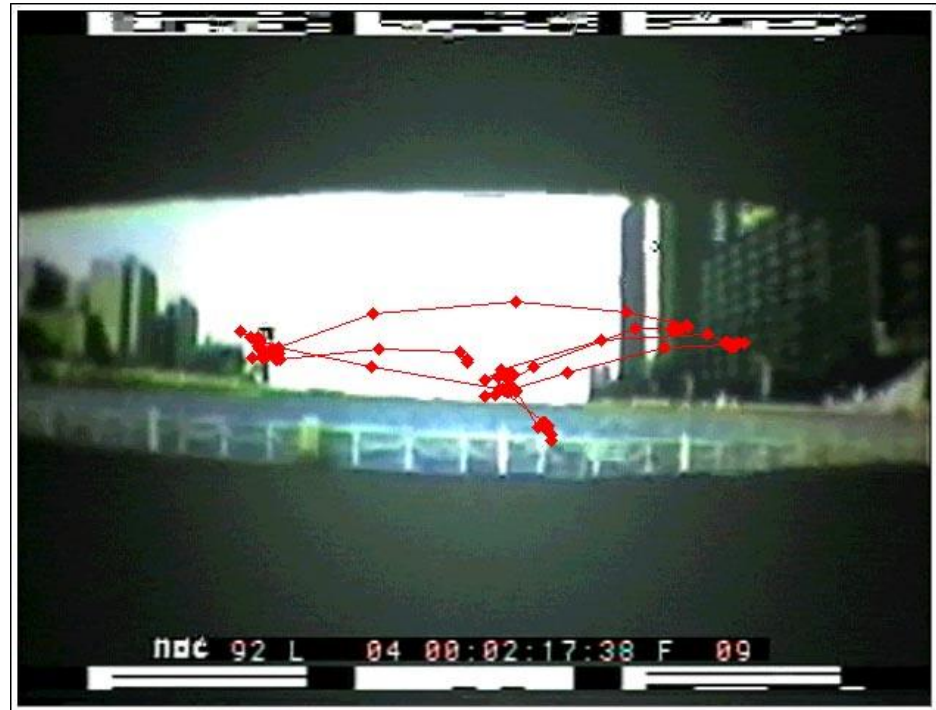


Figure 6 An example of a trace of eye movement (scene II, wall type)

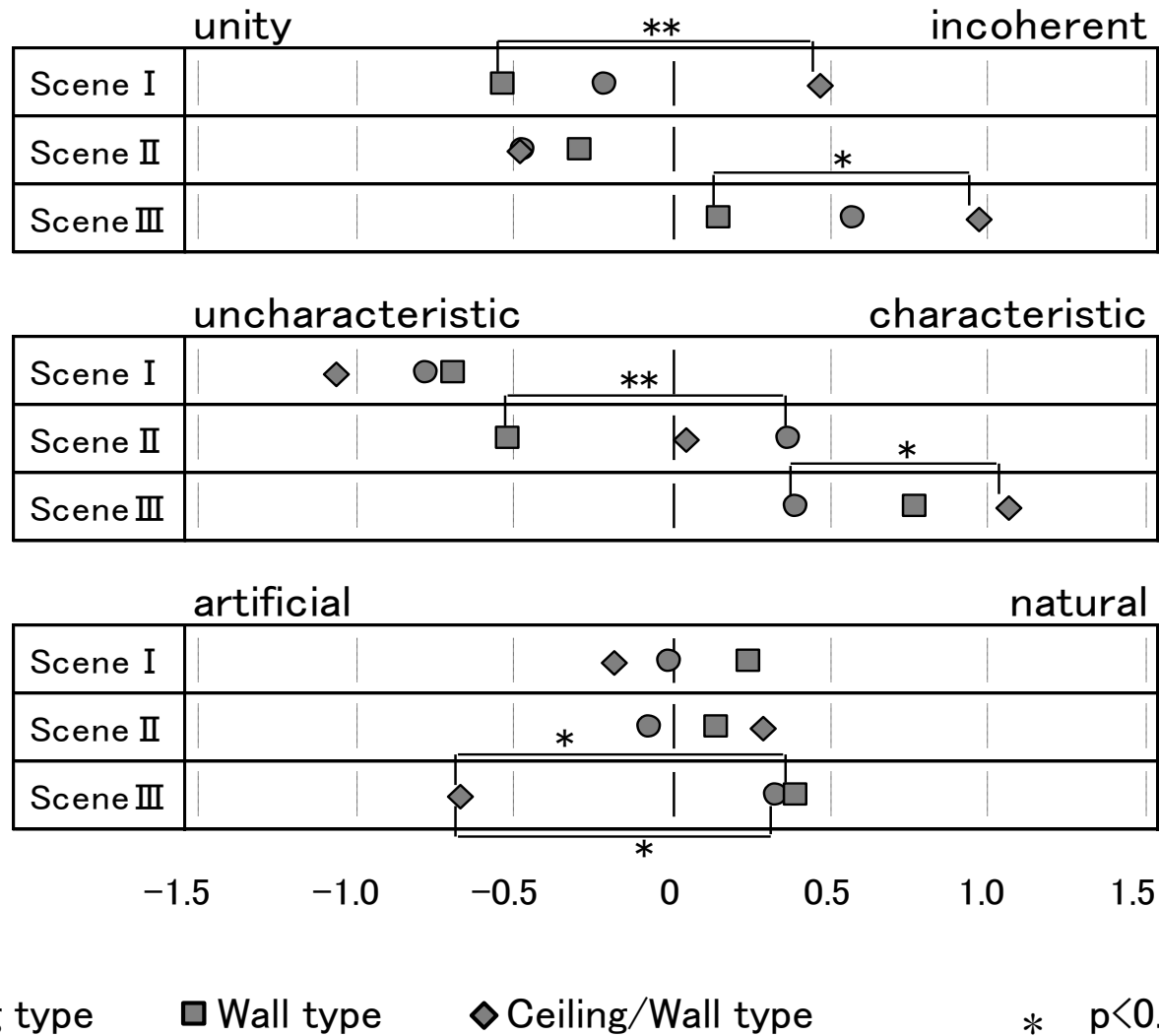
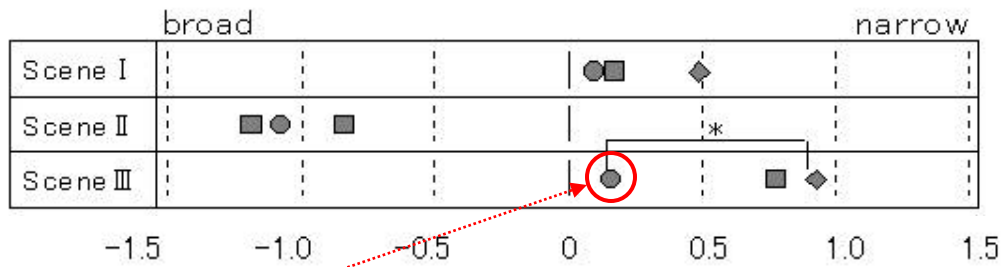
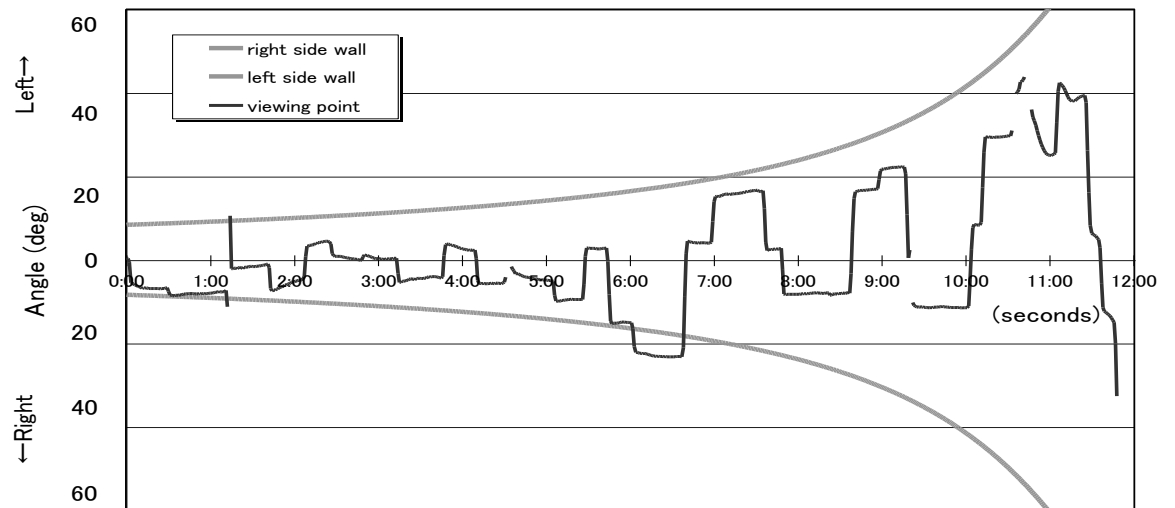
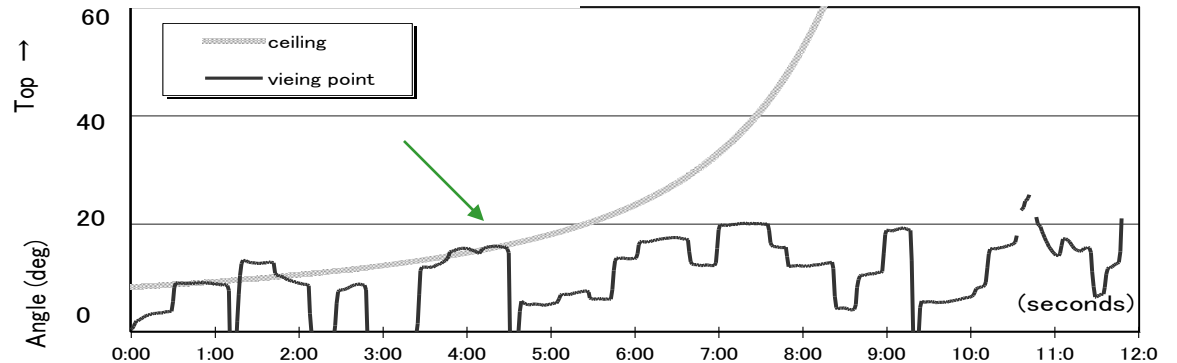


Figure 5-2 The differences of overall impressions according to the type of exit space





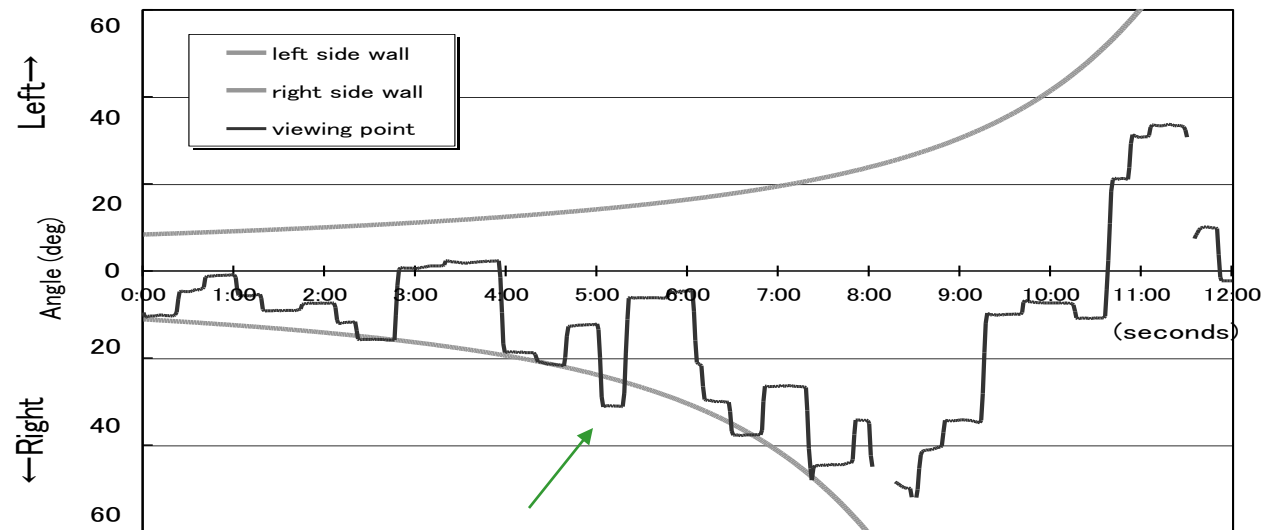
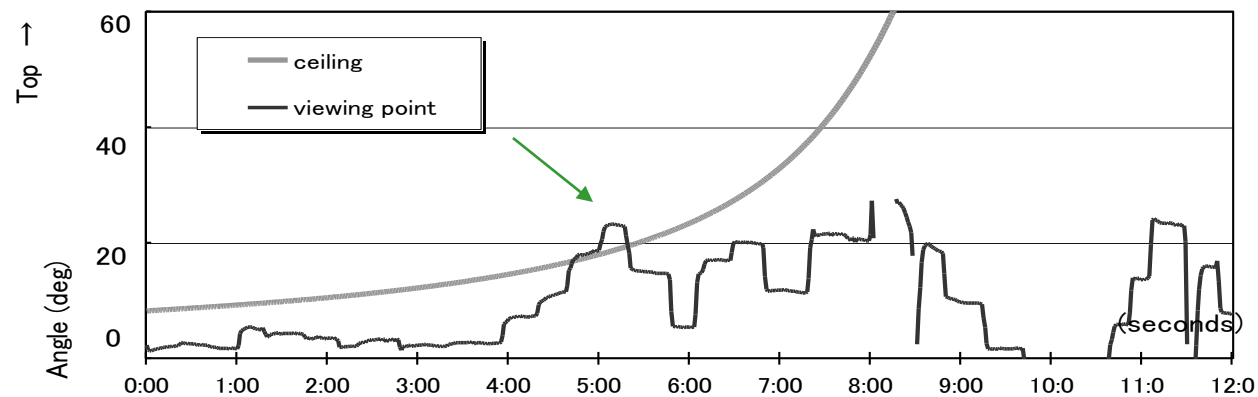
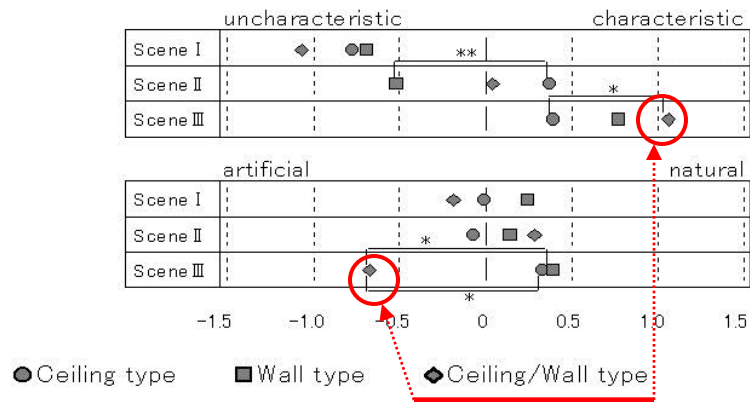
● Ceiling type    ■ Wall type    ◆ Ceiling/Wall type



1. Ceiling type  
-Scene III  
(subject F-5)

[movie](#)

Figure 7-1 A typical eye movement trace



3.Ceiling/wall type  
-Scene III  
(subject E-4)

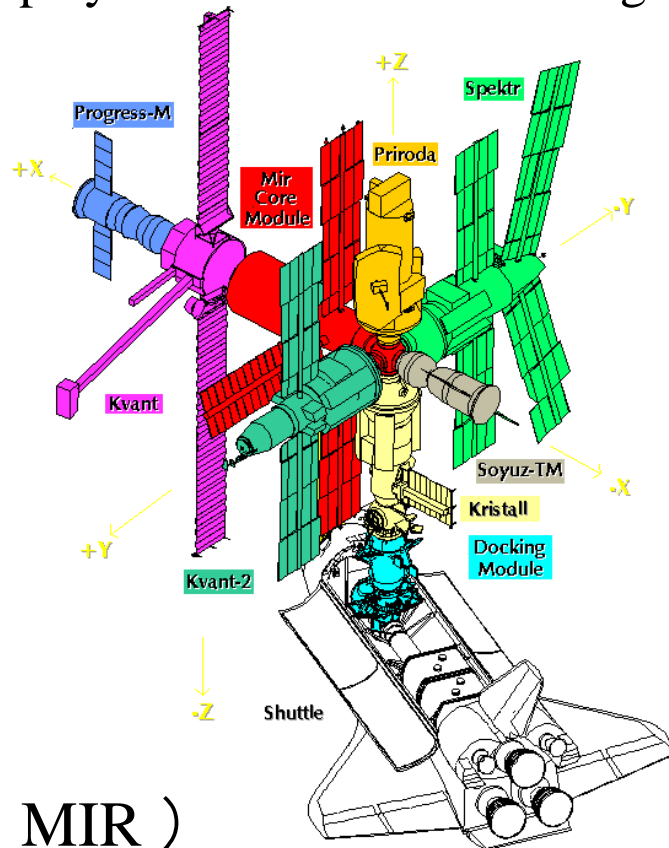
Figure 7-3 A typical eye movement trace



# Spatial cognition in virtual weightless interior space

## 2002

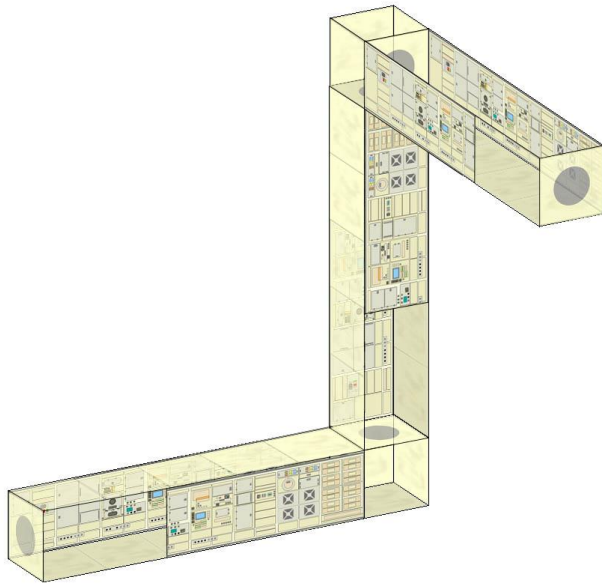
This study intends to clarify how people acquire and recognize their orientation in a zero gravity environment and examine how interior design of a space station help to keep their orientation. A subject wears a head-mounted display and enters a virtual weightless state represented by computer graphics.



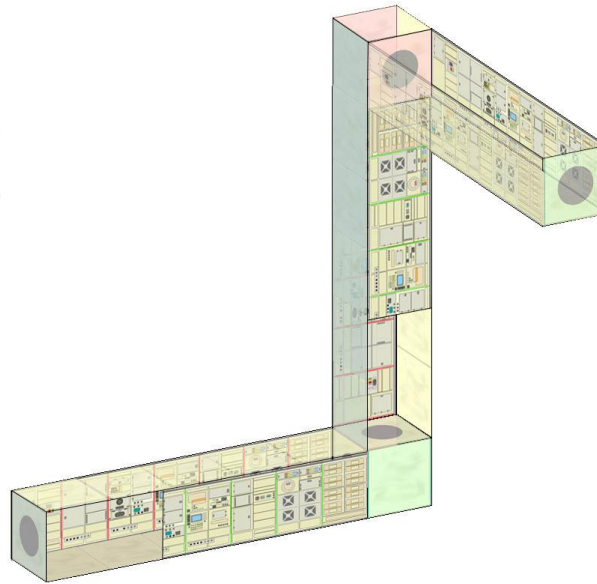
Space station

(ISS)

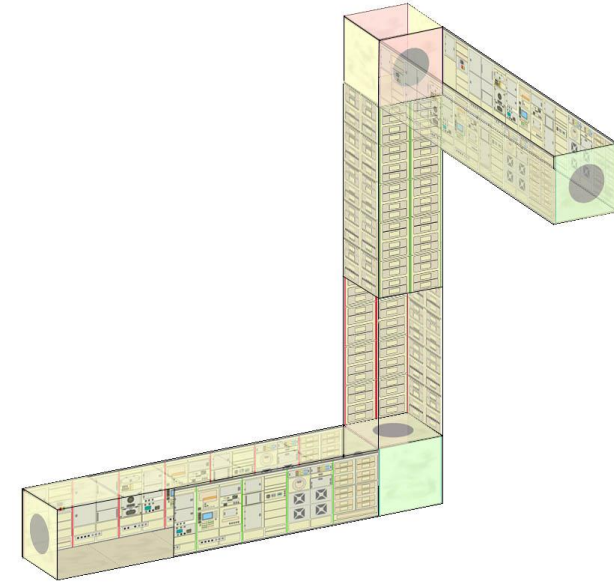
# Three different interior designs



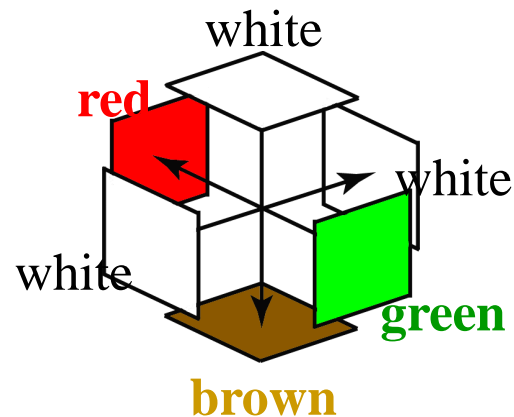
Type I  
(brown floor)



Type II  
(color cording)



Type III  
(color cording and  
the vertical module  
has different  
function)



Color cording rule



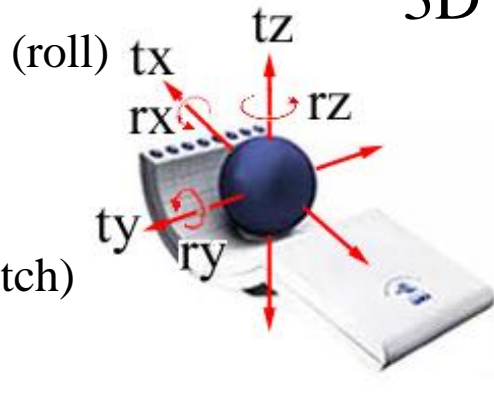
# Procedure of the experiment

Each of 30 subjects (18 male, 12 female ) were asked

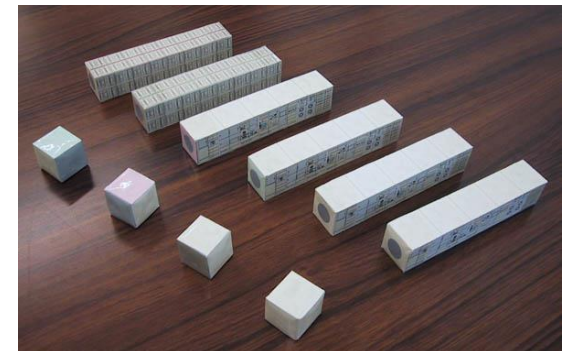
- To learn the rule of the interior design
- To experience (moving through) the virtual space
- To point the start point (Pointing task )
- To make a scale model of the station by connecting parts (Model construction task)
- To do the same for three different types of station
- To repeat 1-5 above procedure for different interior design (altogether 9 sessions =3 interior design x 3 connection types)

(yaw)

3D controller



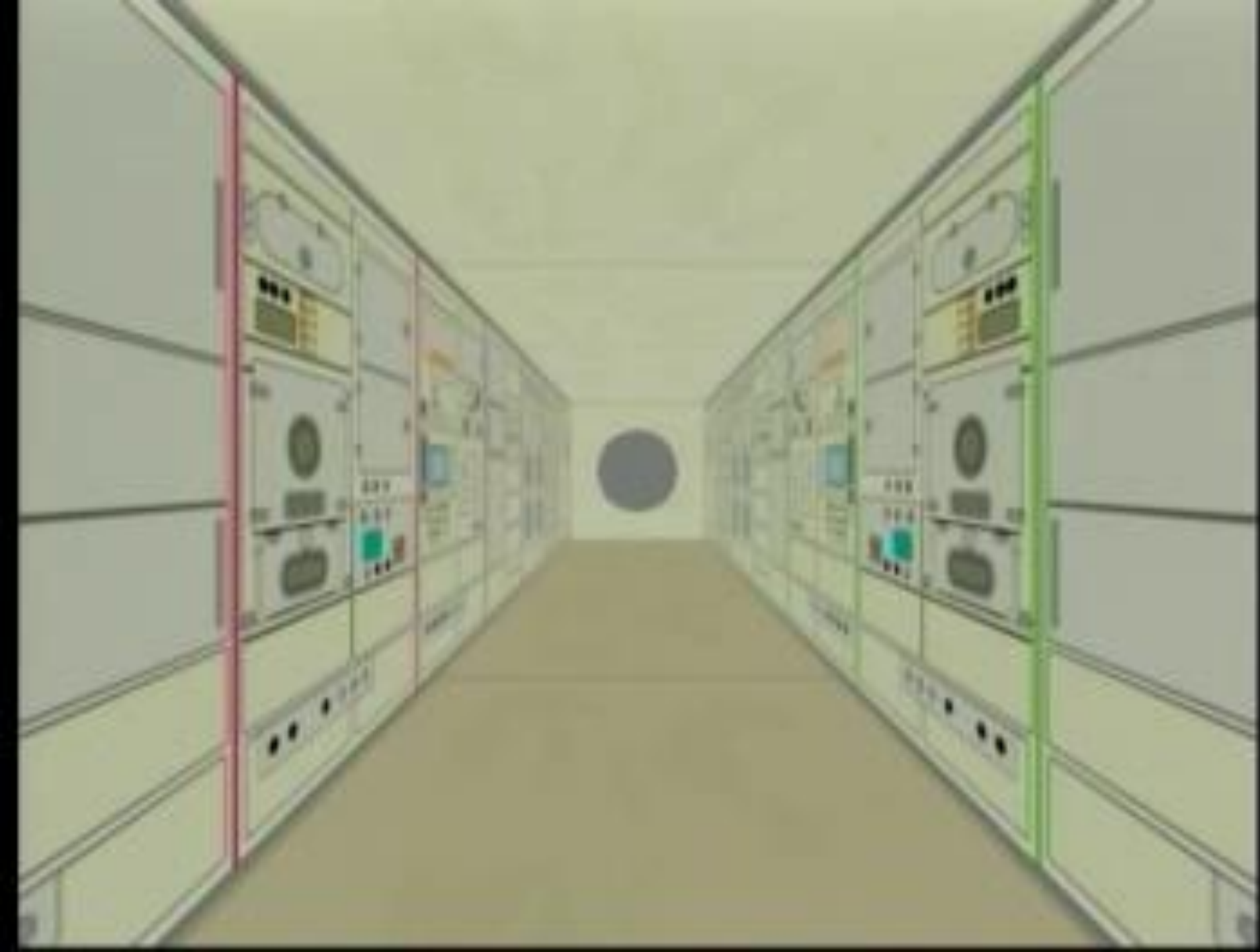
Model construction task



Model parts

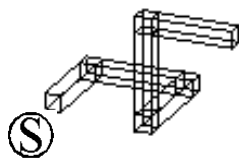
Experiencing the virtual space with HMD





# Result

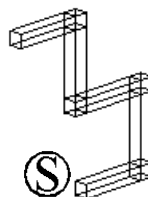
Connection type 1



$\chi^2$ test

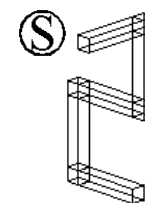
	I	II	III
I	—	**	*
II	**	—	
III	**		—

Connection type 2



	I	II	III
I	—	**	**
II	**	—	**
III	**	**	—

Connection type 3

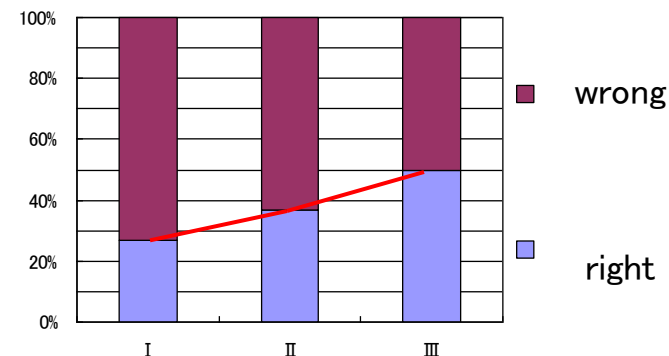
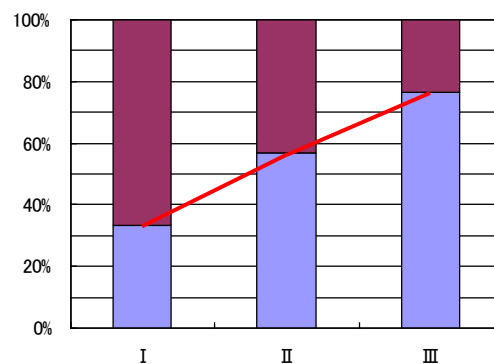
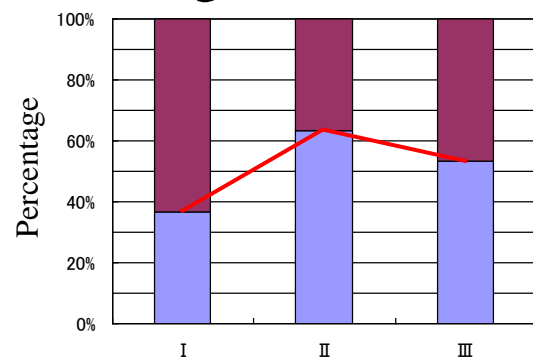


	I	II	III
I	—		**
II	*	—	
III	**		—

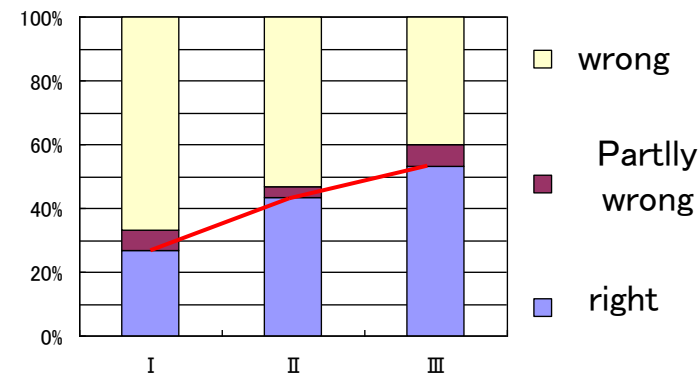
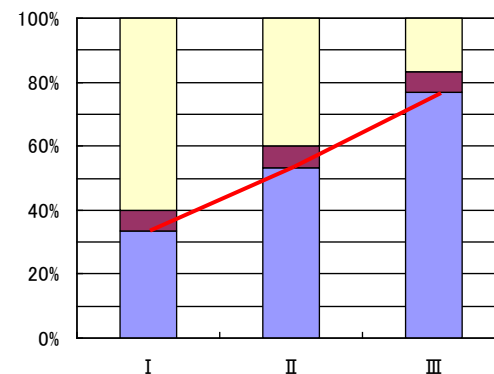
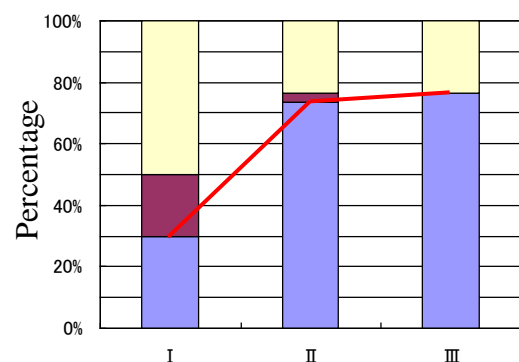
\* p<0.05  
\*\* p<0.01

Pointing Model

## Pointing task



## Model construction task





# **Effectiveness of Design Guideline for improving Streetscapes 2003**

This study examines how those regulations can affect pedestrians' evaluation of the streetscape. A visual simulation system was employed to test how such physical features of buildings as color and height effects the pedestrians' impressions of the street.



## <Method>

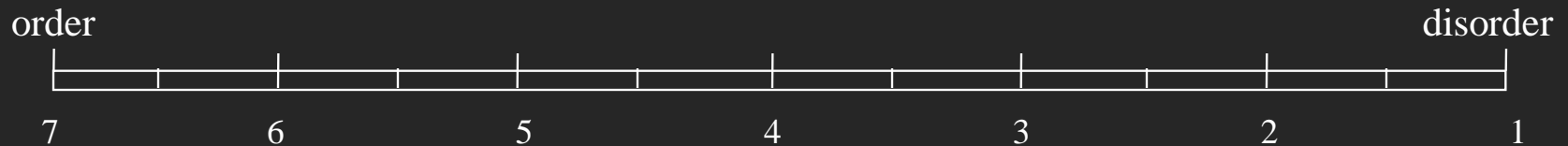
30 subjects observe the movies (17 types)  
for 70 second.

After viewing each movie, subjects rate  
their impressions using the following  
scales.



### < psychological scales >

#### 1. “order vs. disorder”



#### 2. “simple vs. diverse”



#### 3. “good atmosphere vs. bad atmosphere”



# < Generation of the image of the simulated street >



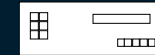
SGI O2

CG animation of cars and pedestrians



The scenes of scale-model street

SONY  
Digital Cromakeyer



Overlay



DV recorder

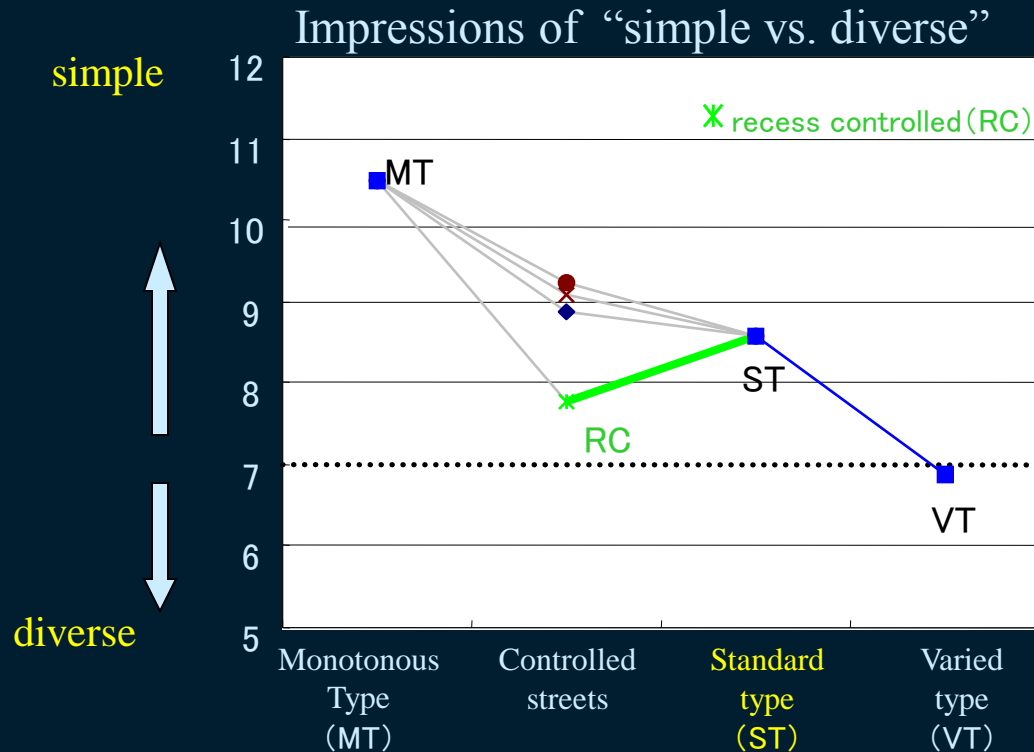


An example of the movie

街路MV


**<Result>** The “recess controlled” street (RC) unexpectedly rated as more varied than the “standard” street.

The reason for this result may be because other variables’ variations became more stand out by aligning the buildings.



It was suggested that the impression of the streetscape is not affected by each component of building design independently but by combination of them. This implies that the regulation of building elements that arbitrary selected has no value as a design guideline.





# Effects of visual experience in approach spaces on impressions of the destination and psychological lift

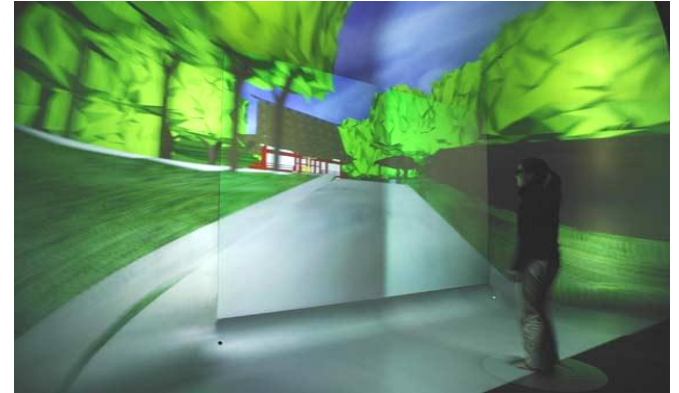
Masashi SOEDA, Ryuzo OHNO, Yosuke Matsuoka  
Naoki HASHIMOTO, Makoto SATO

Tokyo Institute of Technology

# Method

Visual Simulation

six different approach spaces

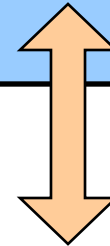


## Psychological evaluation

▪ Impressions of  
the destination



▪ Psychological lift





















## Physical visual factors

- Gaps of the directions between destination and heading
- Changes of visible amount of the building at the destination
- Distance from viewpoint to the surrounding surfaces

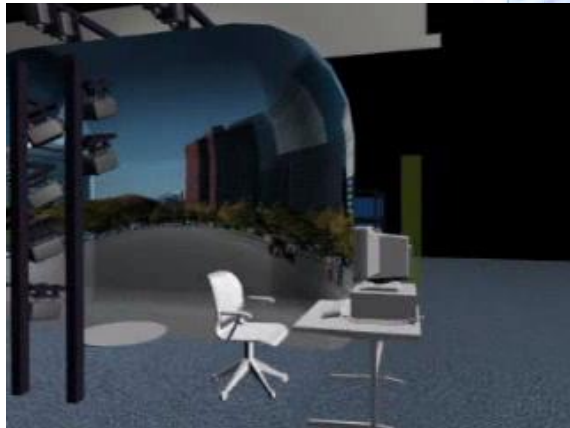
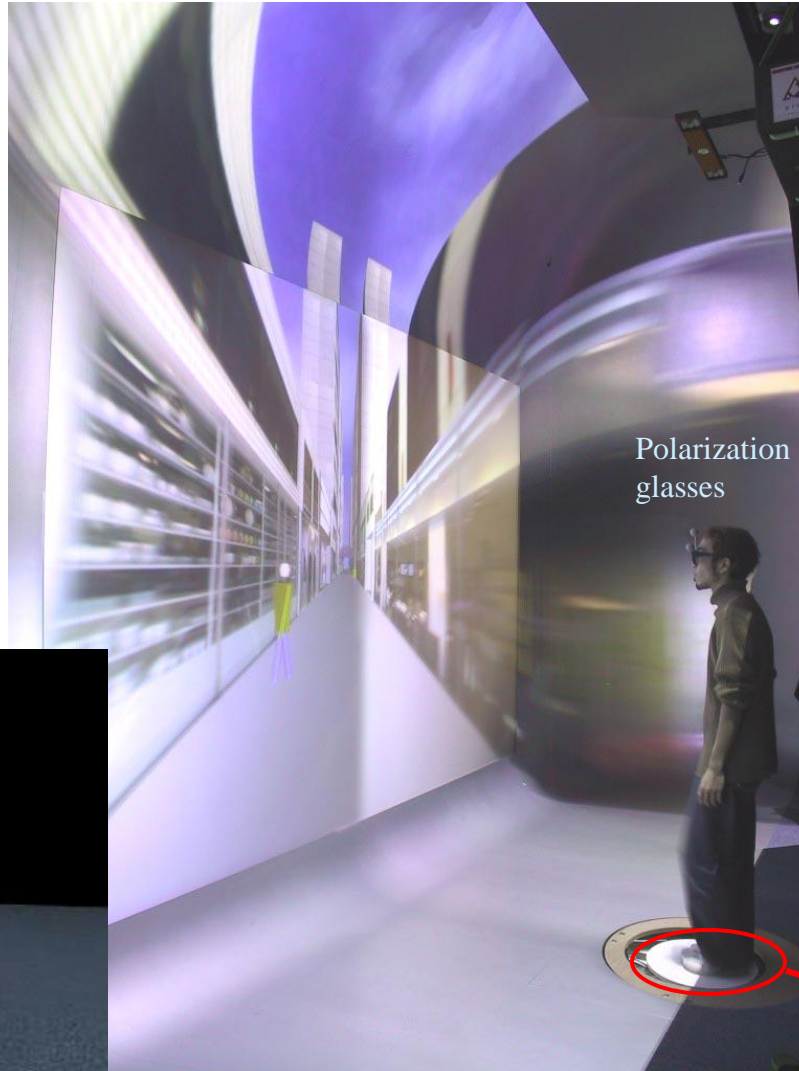
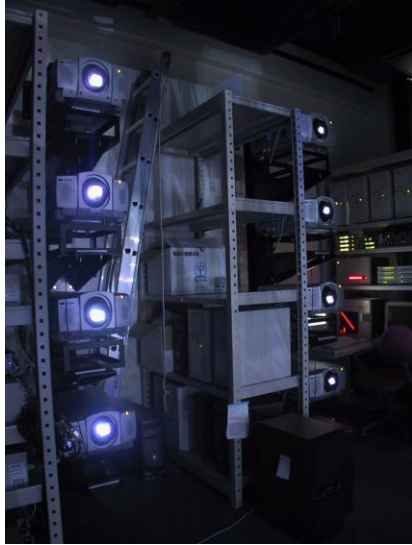
# Experimental settings

## Six approach spaces shown to the subjects

	Name	Flat and Straight	Straight among Trees	Steep Stairs	Gentle Stairs	Flat & Curve	Slope & Curve
	Plan	straight	straight	straight	straight	curve	curve
	Section	flat	flat	stairs	stairs	flat	slope
Visual Factors	Changes of visible amount	slow	slow	quick	slightly quick	slow	slightly quick
	Gap of the direction between heading and the destination	none	none	below	below	left	below left
	Distance from view point to surrounding surfaces	8m(10m)	2.5m	4m	4m	4m	4m
Scenes in the animation shown to the subjects	Start						
	Middle point						
	Goal						



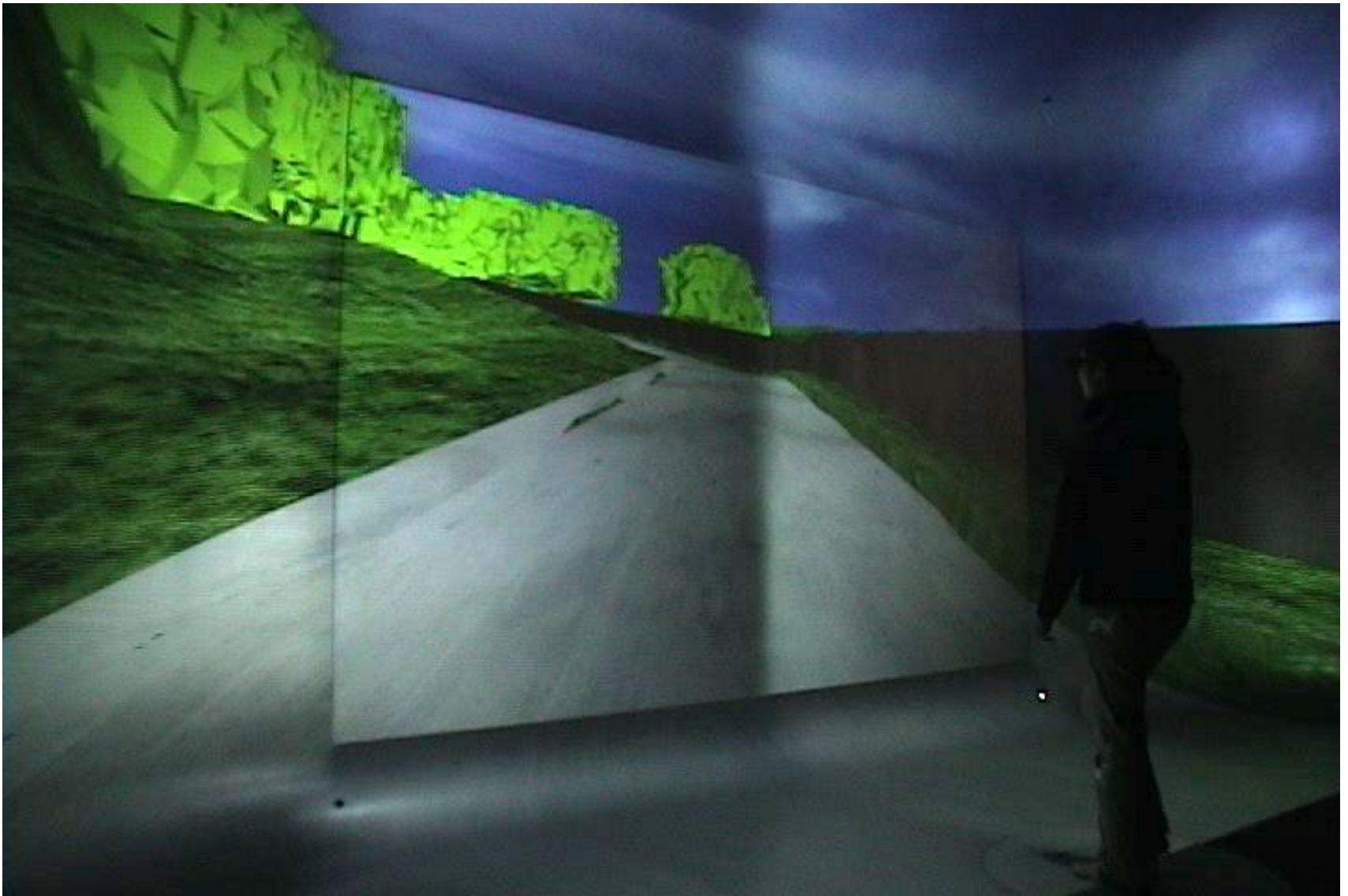
# ◇ Visual Simulation System



Stepping Interface



A subject in the experiment

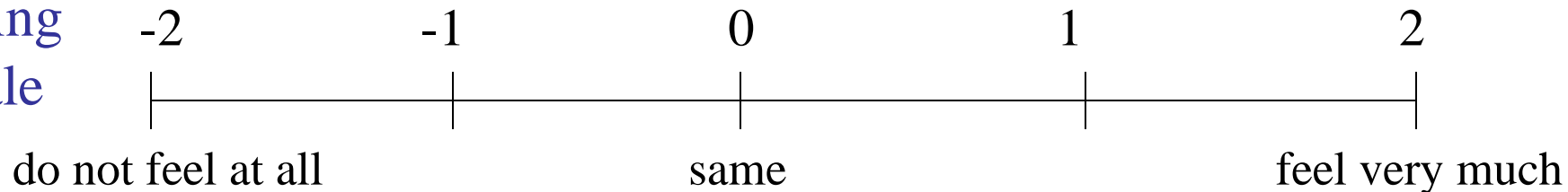


# Procedure

## Evaluating the impression of the destination

Items	“dignity”, “familiarity”, “calm”, and “unusual”
Method	pair comparison, 5 scale

rating  
scale



## Evaluating psychological lift

Method	sliding up a lever of a device
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subjects : 18 students (11male, 7 female)

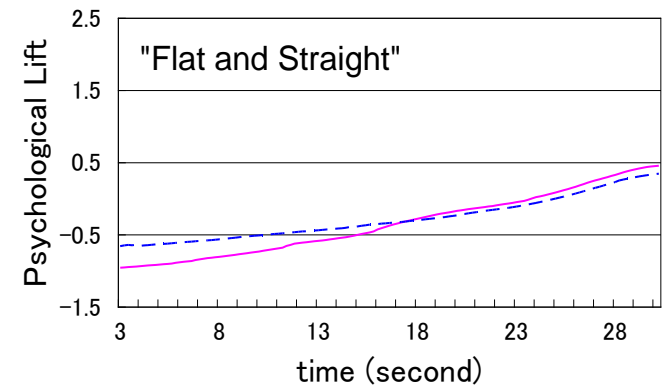
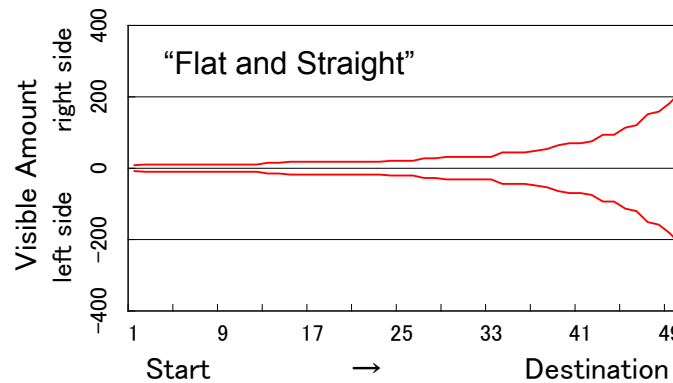




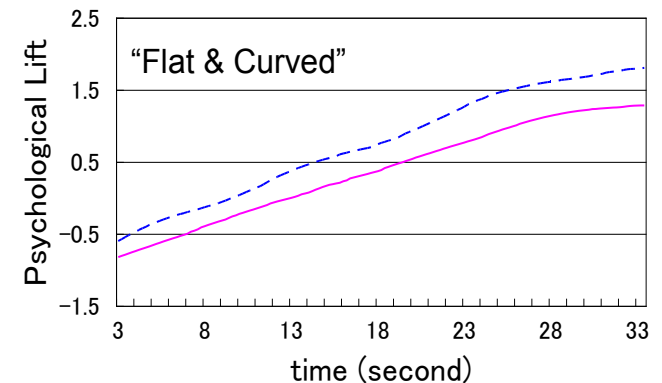
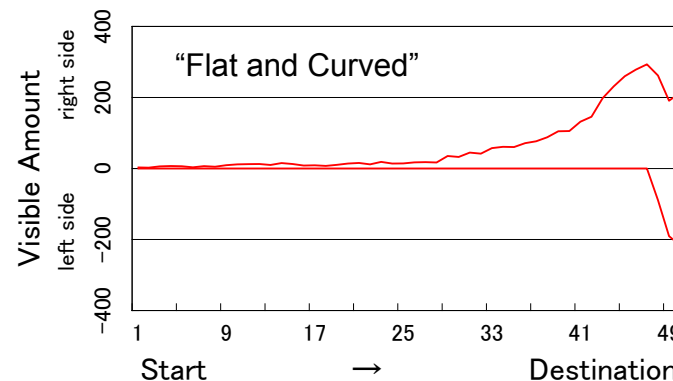
# Result

## Influence of approaching direction

### Flat & Straight



### Flat & Curved



— shrine    ..... museum

完