CyberTherapy 2005, Basel

# The application of a VR-tangible interaction system in sensory integration training and assessment for children with autism

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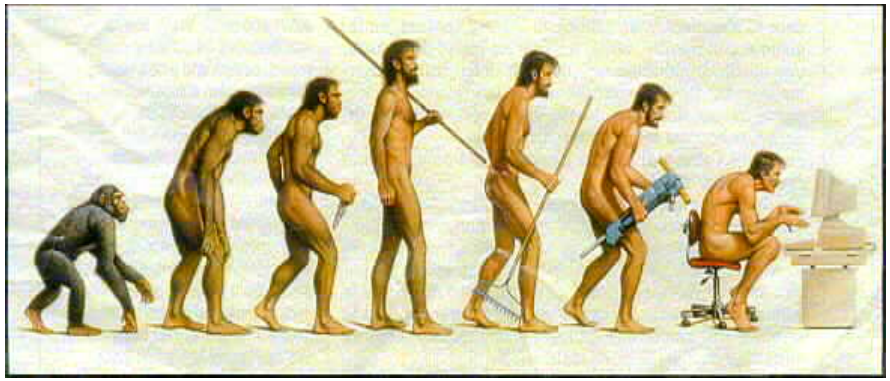
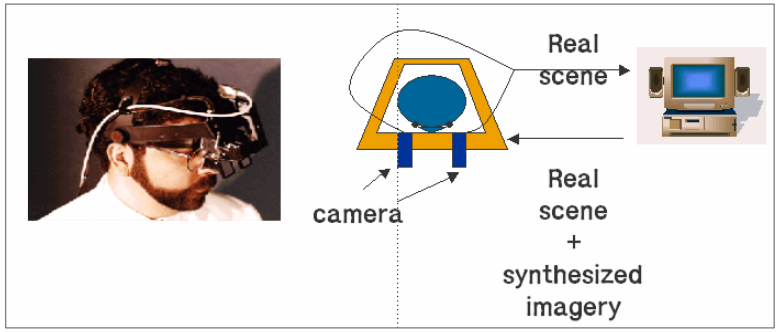
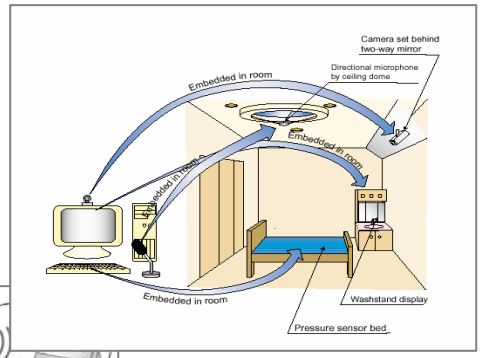
# *The Evolution of the Tool-Using Animal*

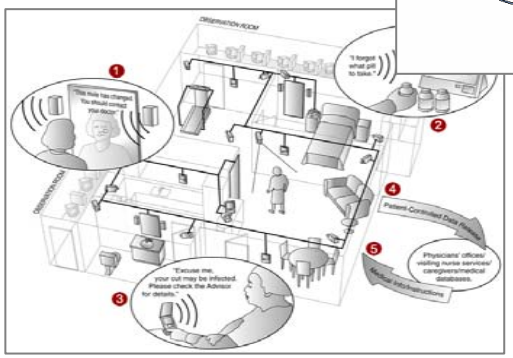


CAVE



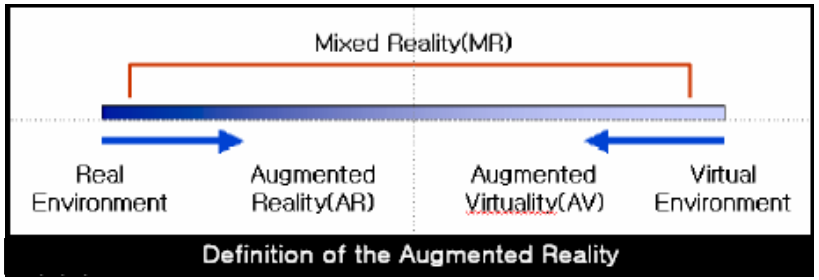

See through HMD



Ubiquitous
VR or AR

# Augmented Reality

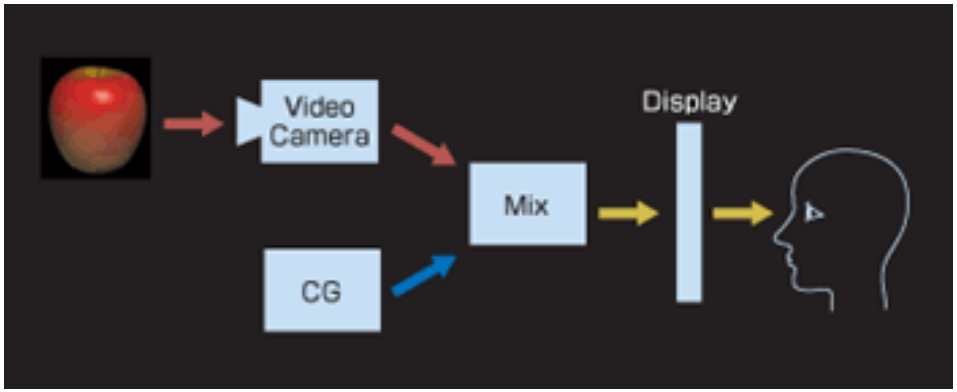



A view in which a computer superimposes images onto the user's field of vision

Virtual advertising

# *Mixed Reality*

An environment that combines elements of both virtual reality and the real world




Overview of Video See-Through MR Technology

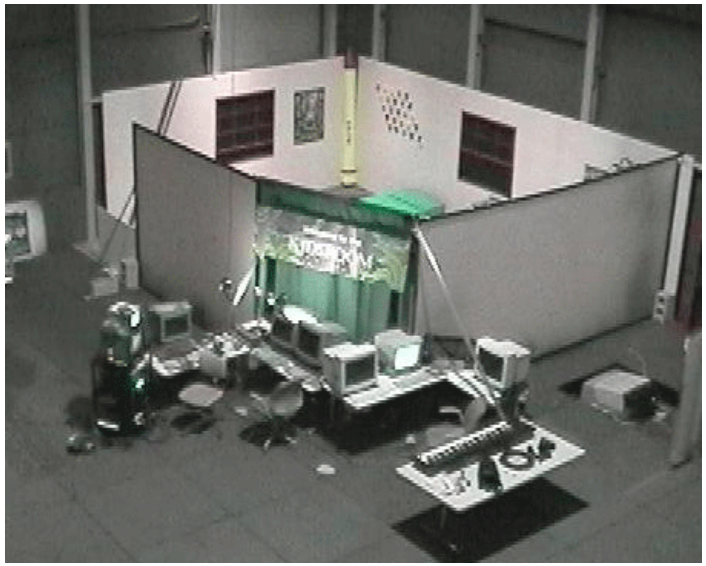
See through HMD

ARQuake

Mixed Reality (MR), the term we use to describe the creation of a feeling of composite reality, is a technology for seamlessly merging the real and the virtual worlds in real time

# *VR-Tangible Interaction Design*

Tangible interaction systems are physically embedded in real space and combine real space with virtual displays.



MIT's Kids Room Project

# *VR-Tangible Interaction Design*

Tangible interaction is bodily interaction with physical (tangible) objects/devices. Input is done by physical manipulation.

Combine visual graphics and Glass Xylophone performance.

Glass Xylophone

# *VR-Tangible Interaction Design*

Tangible Interaction is about physical representation of data.

– VR Class

1) Players live in the different situations
2) Live Agent
3) VR–tangible interaction system

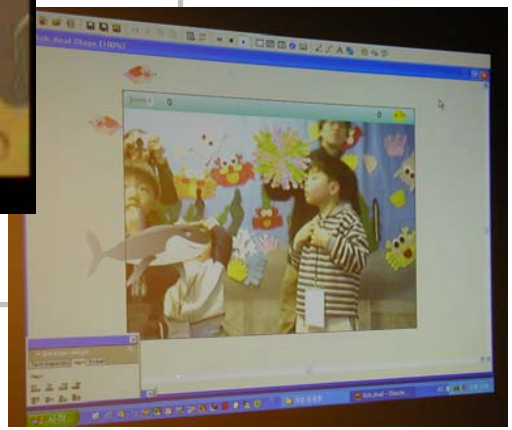
– Tasks

1) Practice with a live agent
2) Contest with the other player

# *VR-Tangible Interaction Design*

With Tangible Interaction Systems structure is not only in software, but also physical. They can truly embody facilitation methods.

'Save Fishes from a Shark'



Game : "Find treasures under the ground" etc

Task : shake hands to move an excavator

# *Sensory Integrative Dysfunction of Autism*

Sensory Integrative Dysfunction is
- a disorder in which sensory input is not integrated or organized appropriately in the brain,
- and may produce varying degrees of problems in development, information processing, and behavior.
- autism & other developmental disorders, learning disabilities, brain injury, stress related disorders etc.

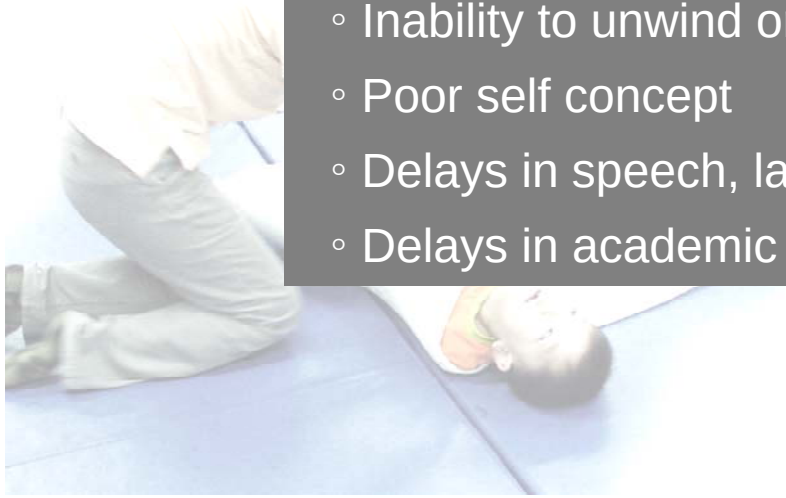
Sensory integration dysfunction is a common symptom of Autism.

Often an autistic child receives too much information through his senses, and in order to turn down the volume, he avoids people, noises, and bright lights.

The autistic child has not learned to integrate and modulate the information from his five senses.

## What are some signs of Sensory Integrative Dysfunction?

- Overly sensitive to touch, movement, sights, or sounds
- Under reactive to touch, movement, sights, or sounds
- Easily distracted
- Social and/or emotional problems
- Activity level that is unusually high or unusually low
- Physical clumsiness or apparent carelessness
- Impulsive, lacking in self control
- Difficulty making transitions from one situation to another
- Inability to unwind or calm self
- Poor self concept
- Delays in speech, language, or motor skills
- Delays in academic achievement



# *Sensory Integrative Intervention for Autism*

A. Jean Ayres, PhD, OTR

A theory of sensory integration and treatment has been developed by Dr. A. Jean Ayers from studies in the neurosciences and those pertaining to physical development and neuromuscular function.

Sensory integration is an innate neurobiological process and refers to the integration and interpretation of sensory stimulation from the environment by the brain.

Sensory integration focuses primarily on three basic senses - tactile, vestibular, and proprioceptive.

**What is Sensory Integration Treatment?**

"We can enhance the functioning of the client's nervous system by providing the client with opportunities to take in enhanced sensory information in the context of active participation in activities that are meaningful to the client, and that elicit adaptive behaviors." (Jean Ayres, 1979)

Sensory integration is a movement-based therapy

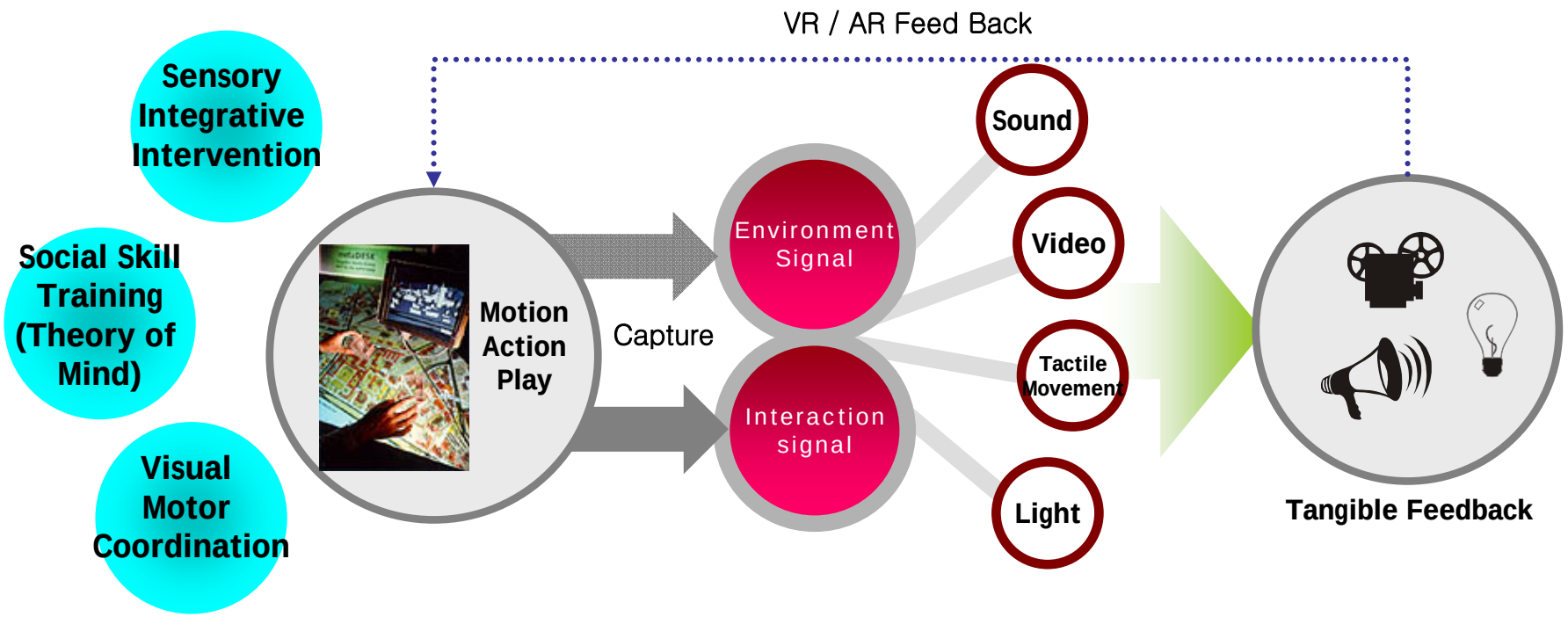
- encourages gross movements in many planes using large pieces of therapeutic equipment
- ex) suspended equipment, scooter boards, tunnels, therapy balls, tactile mediums, and vibration, etc.

This equipment promotes movements including flexion, extension, and rotation, movement of the body in space, and movement of the body in relation to objects in the environment.

As children participate in movements, sensory information from the proprioceptive, vestibular, and tactile systems is produced requiring the nervous system to process, organize, and integrate the information.

# *Sensory Integrative Intervention for Autism*

# Outline of Our System




1 Tangible Input Device

2 Motion Capture Gesture Analysis

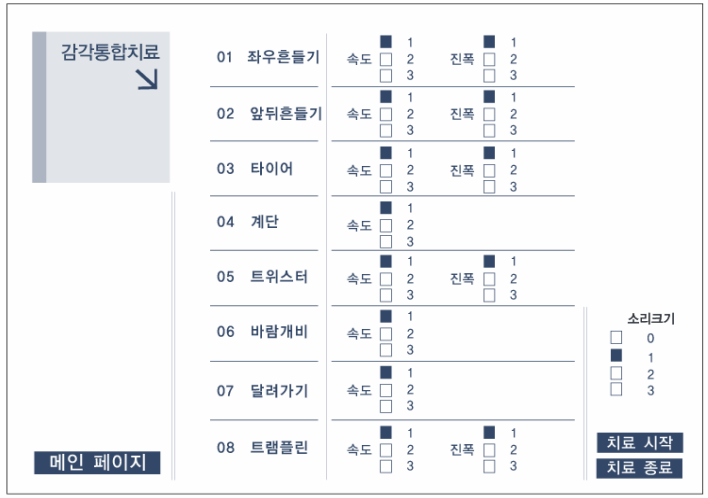
3 VR Simulation System Analysis

4 Tangible Output Device

5 Composition

# Main screens

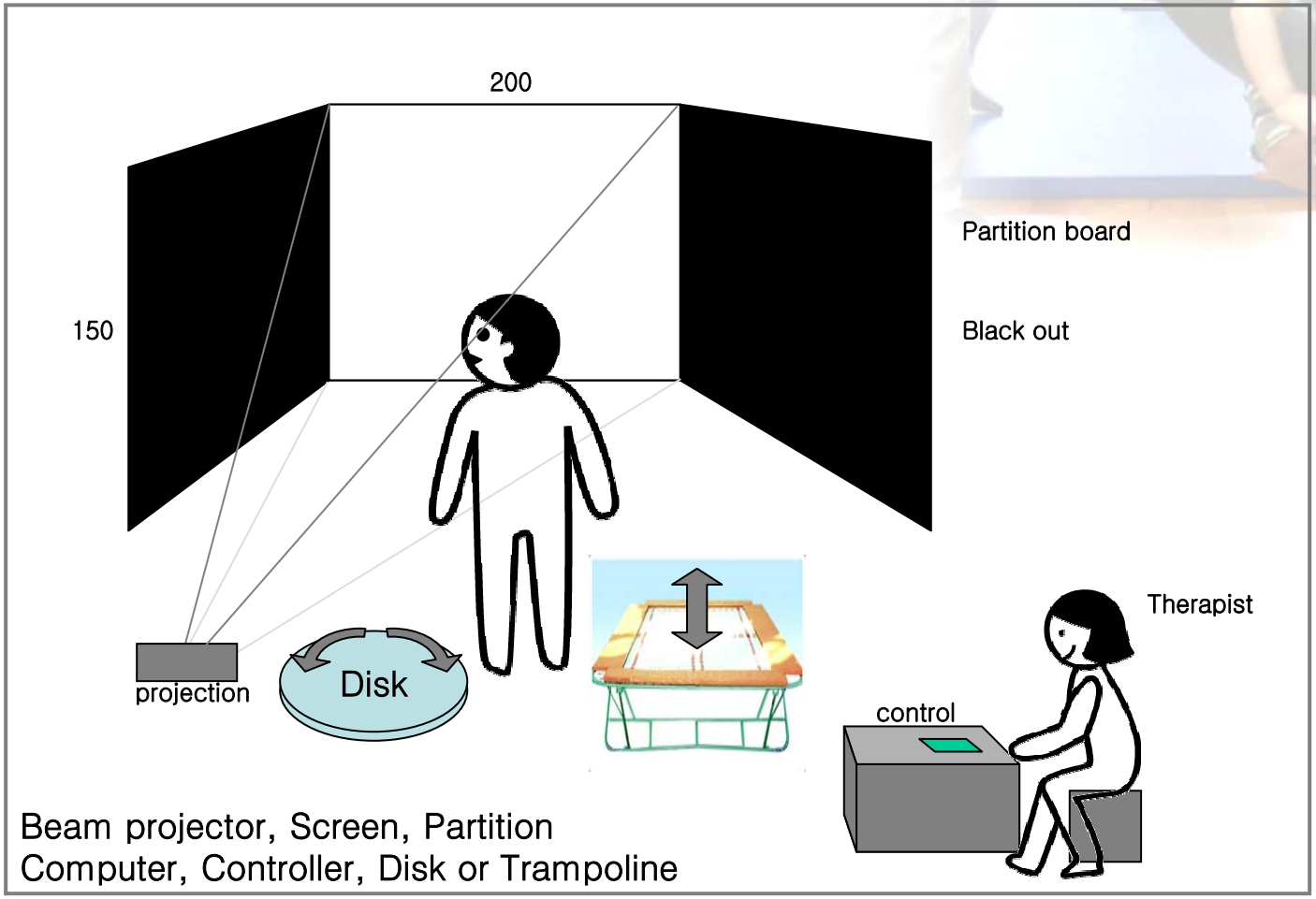
Sensory Integration Program



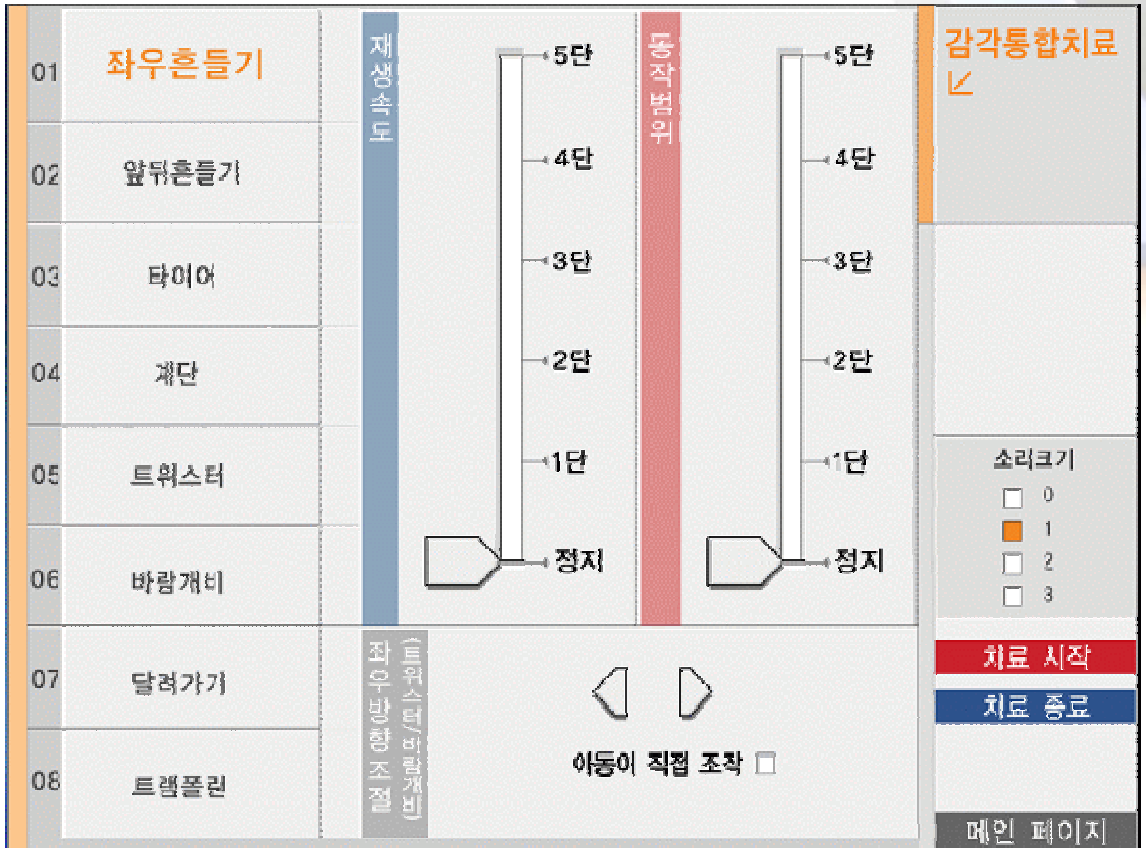
Visual Motor Coordination Program

Social Skill Training Program

# 1. Sensory Integrative Intervention Program

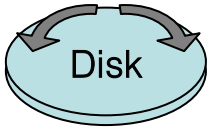


Options of each program
(speed & range)



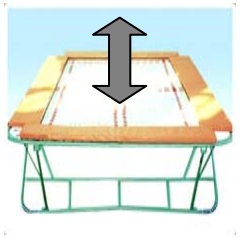

8 Programs

Child's control



**Swing right and left**

**Swing back and forth**



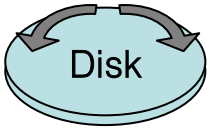
Level 1

Level 2

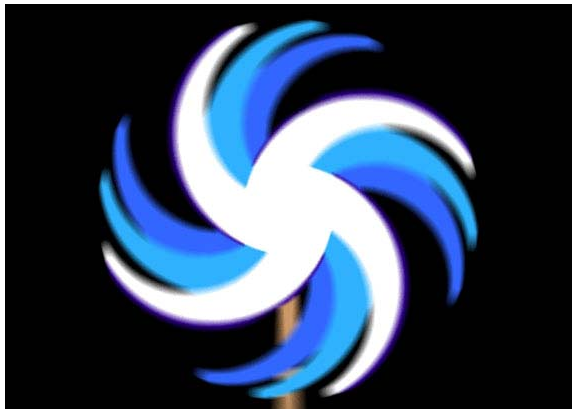
Level 3

Level 4

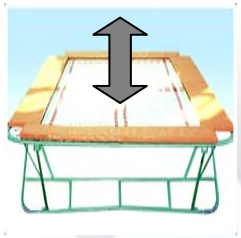
**Go up the stairs**



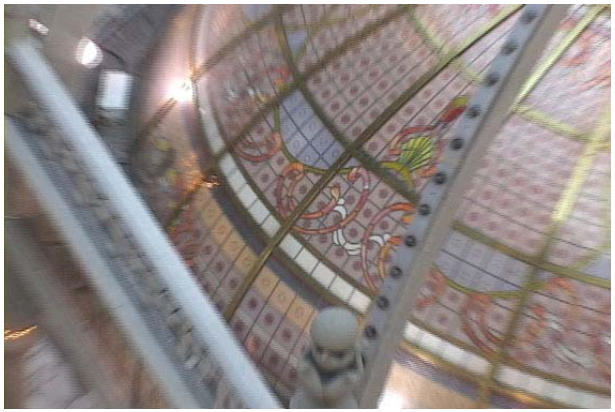
Twirling : merry-go-round



Twirling : pinwheel

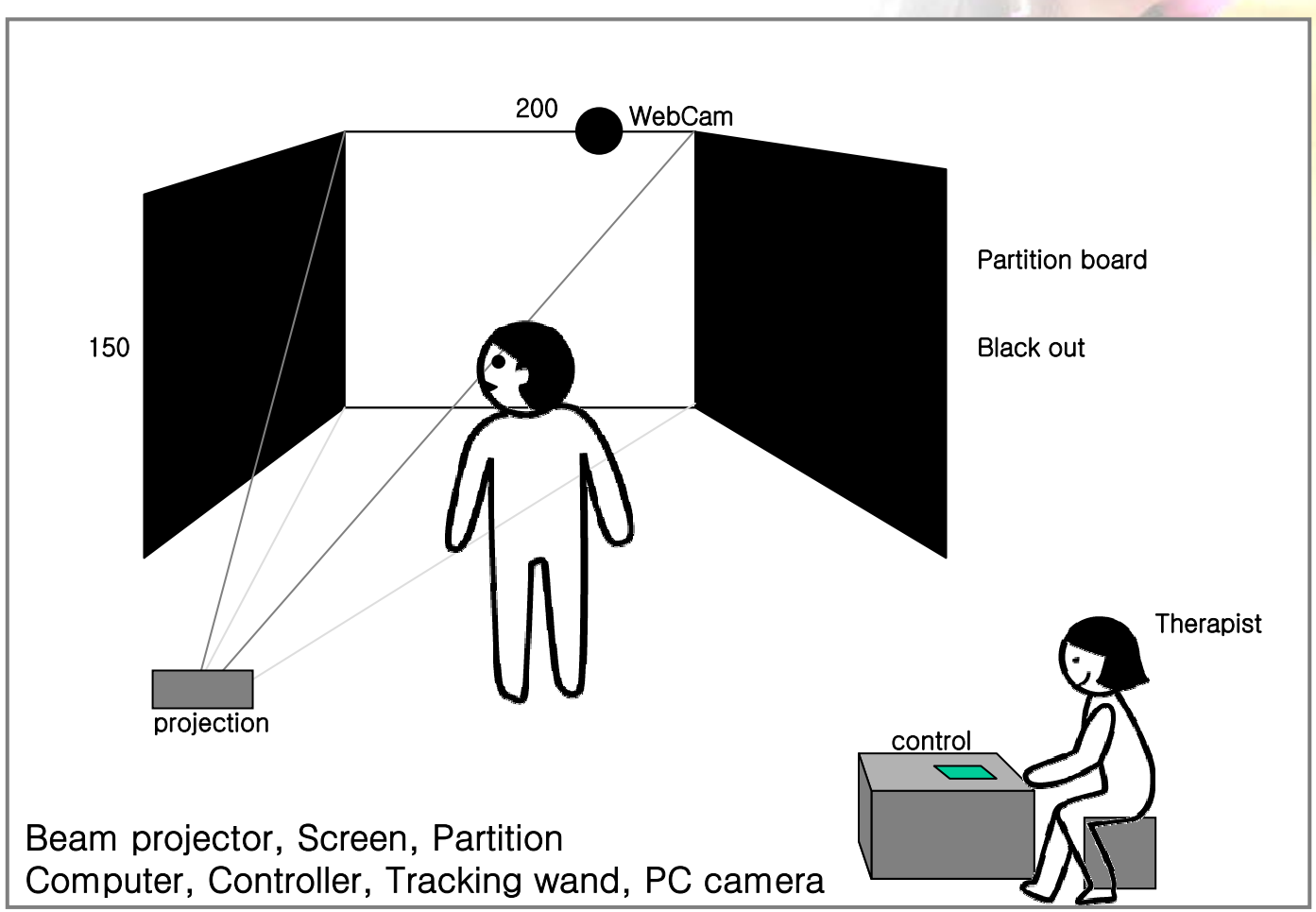


**Linear movement**



**Jumping**

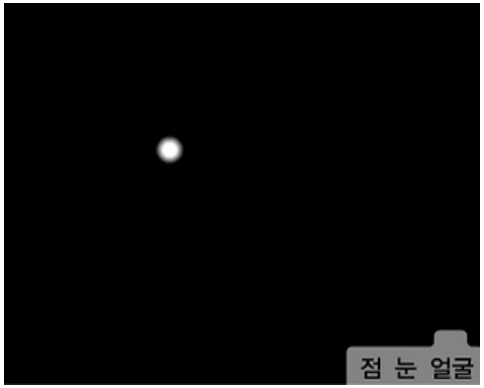
# 2. Social Skill Training Program




Beam projector, Screen, Partition
Computer, Controller, Tracking wand, PC camera

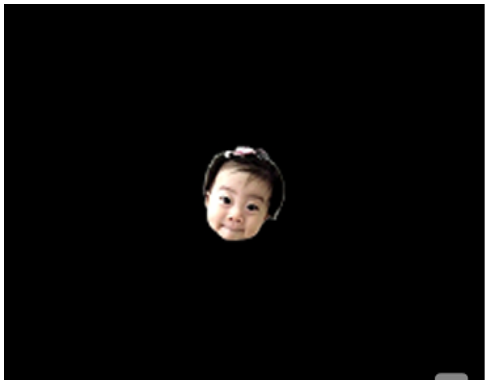
5 Programs

Options of each program




Dot

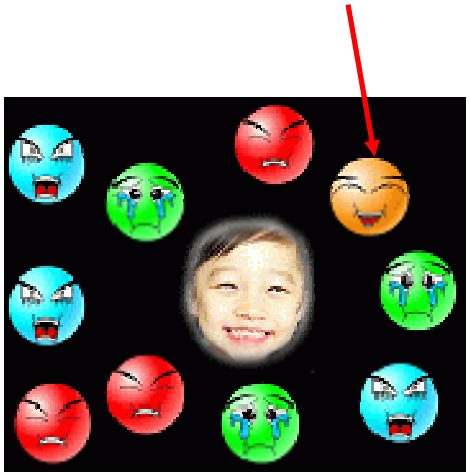
Eyes



Face

**Level 1 : Chase a dot, eyes, face**

Therapist's selection

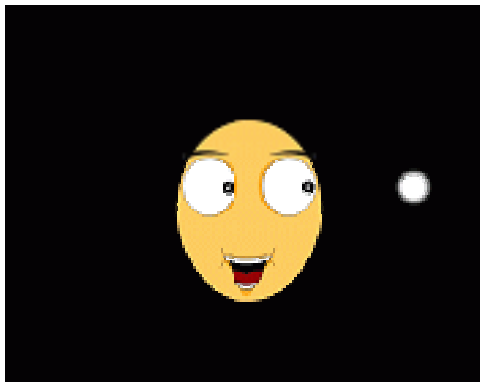


Selective screen

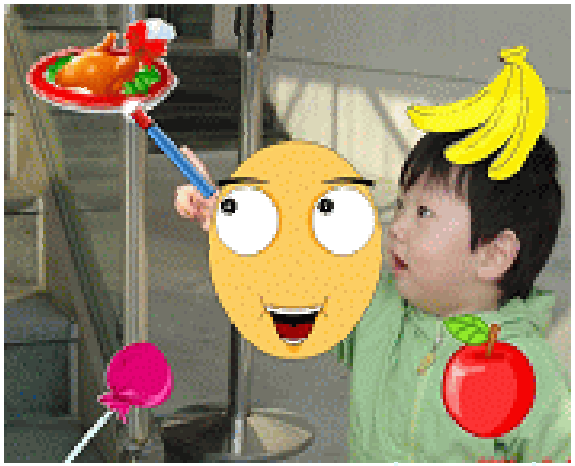
Movie

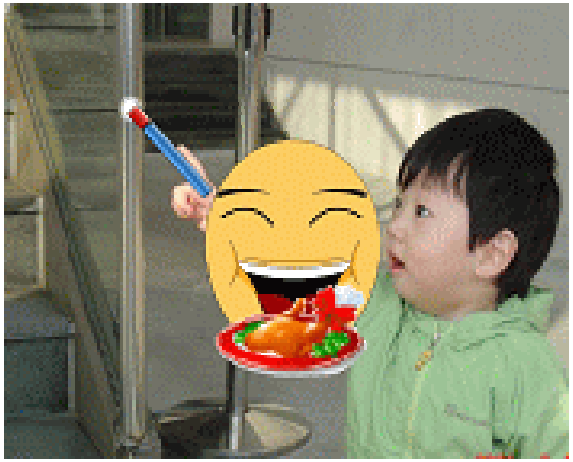
**Level 2 : Facial expression**

Level 3 : Advanced face selection



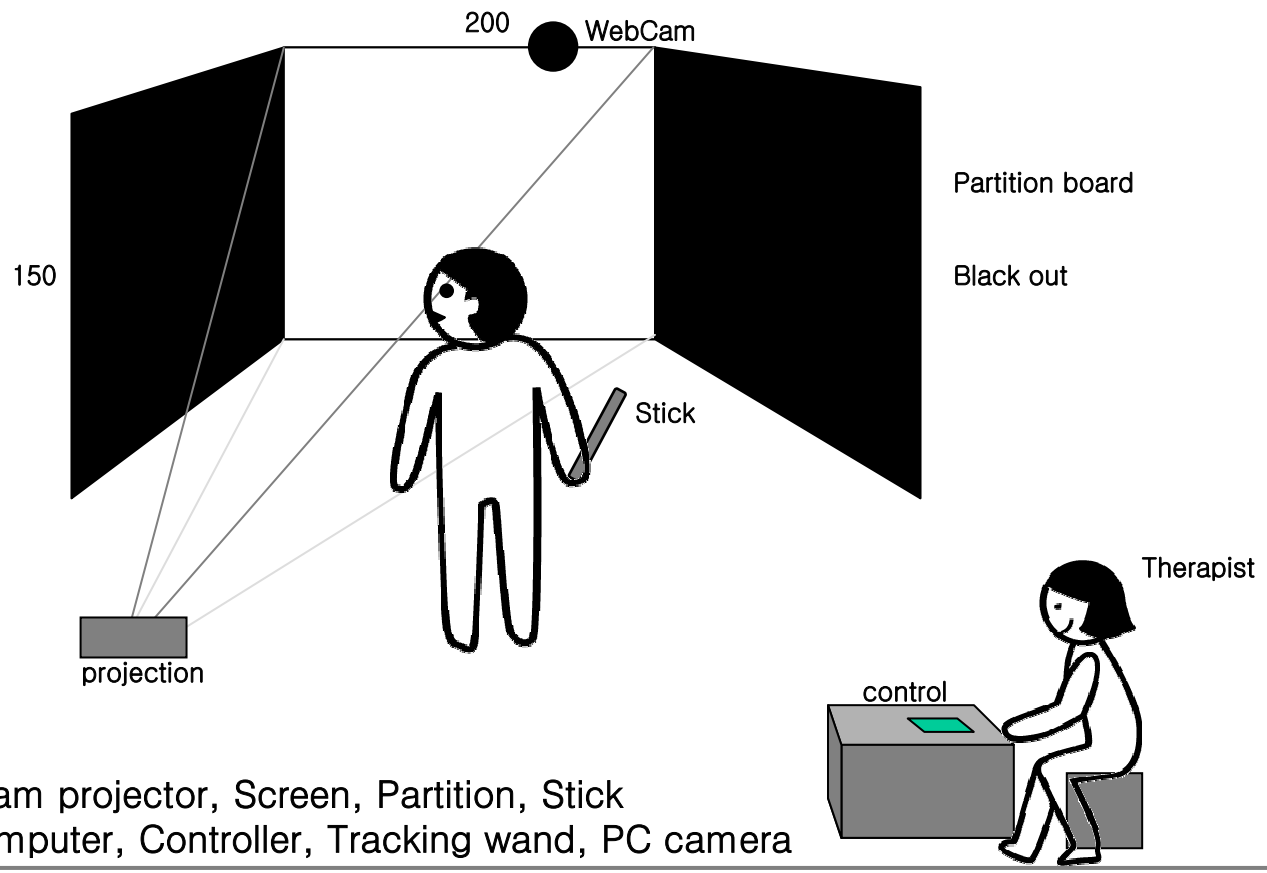
Level 4 : Line of vision



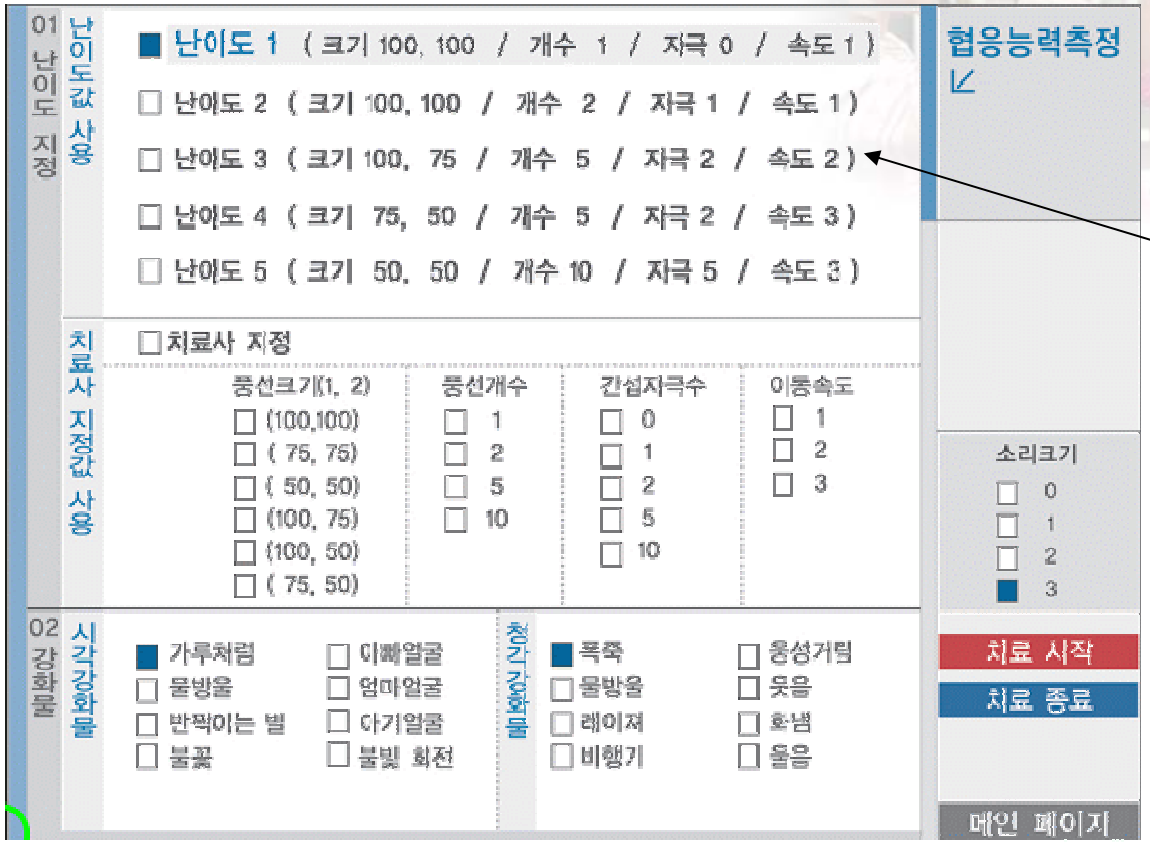


**Level 5 : Select the correct line of vision**

# 3. Visual Motor Coordination Assessment Program




Beam projector, Screen, Partition, Stick
Computer, Controller, Tracking wand, PC camera



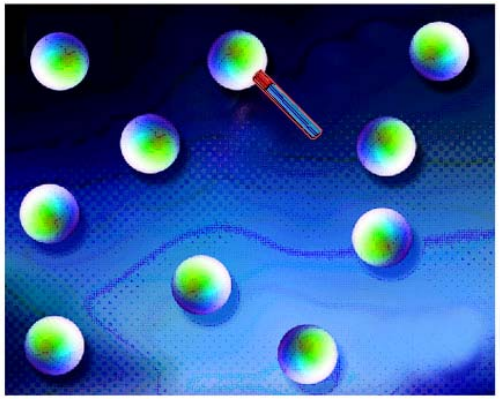

Difficulty levels

Options of stimuli

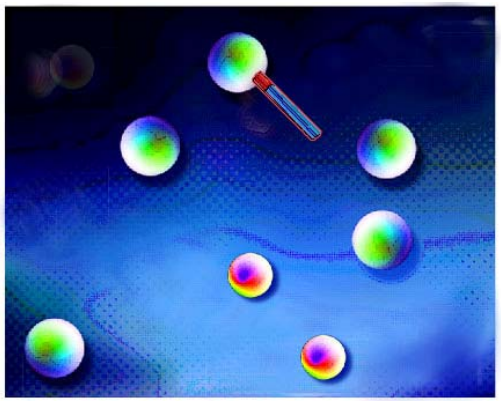
Test trial
(end of every sessions)

Visual reinforcements

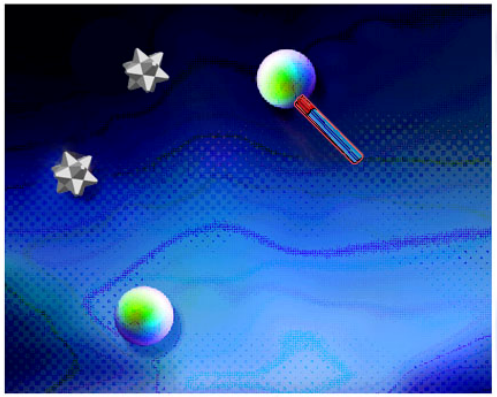
Auditory reinforcements



Balloon [Size 100%] 10

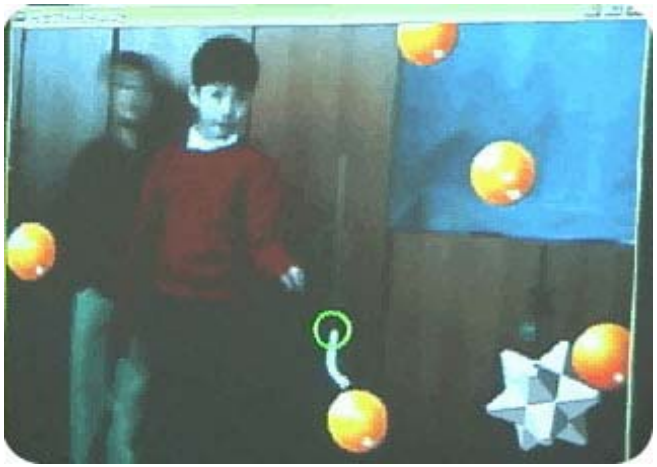


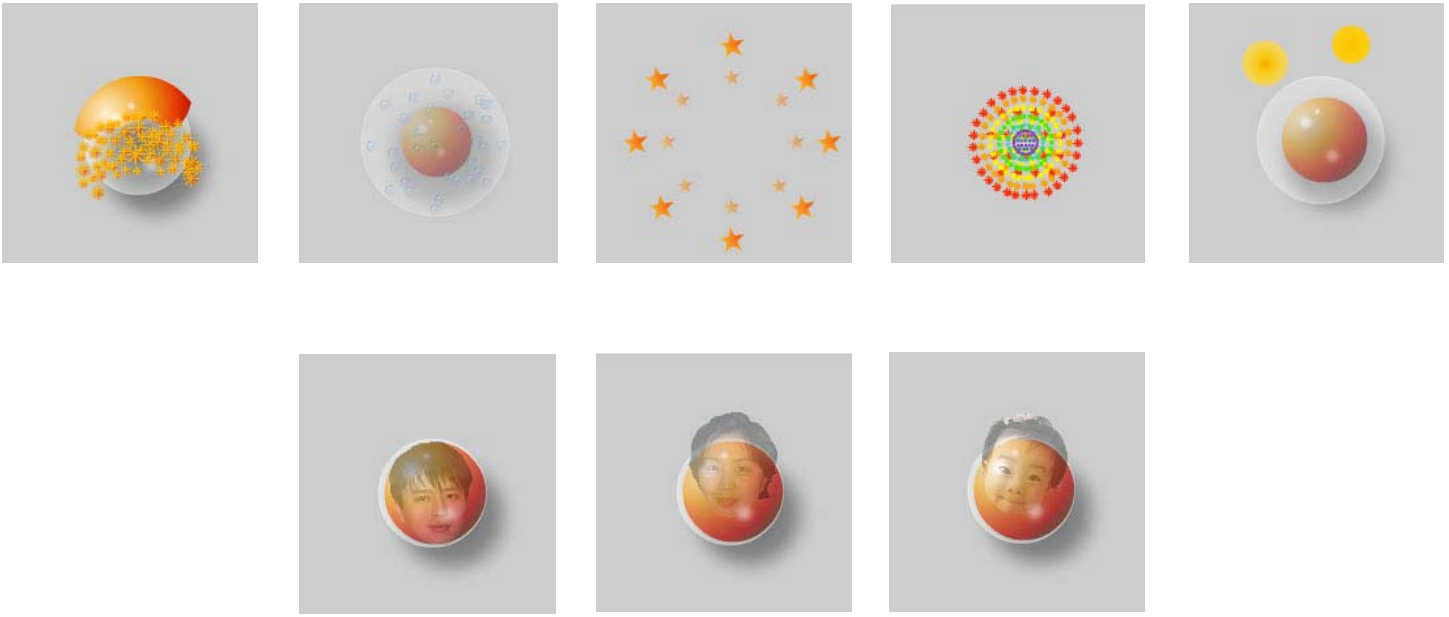
Balloon [Size 100%] 5 + [75%] 2



Balloon [100%] 2 + Cubic 2

**Level 1 : Burst virtual balloons using a real stick**






**Visual reinforcements**

Laugh, Cry, Anger, Fear, Noise, Chat, Laser, Firecracker

**Auditory reinforcements**

# *Preliminary Experiments*

- Validity and reliability of our system
- Effects of the intervention
- Characteristics of autistic children

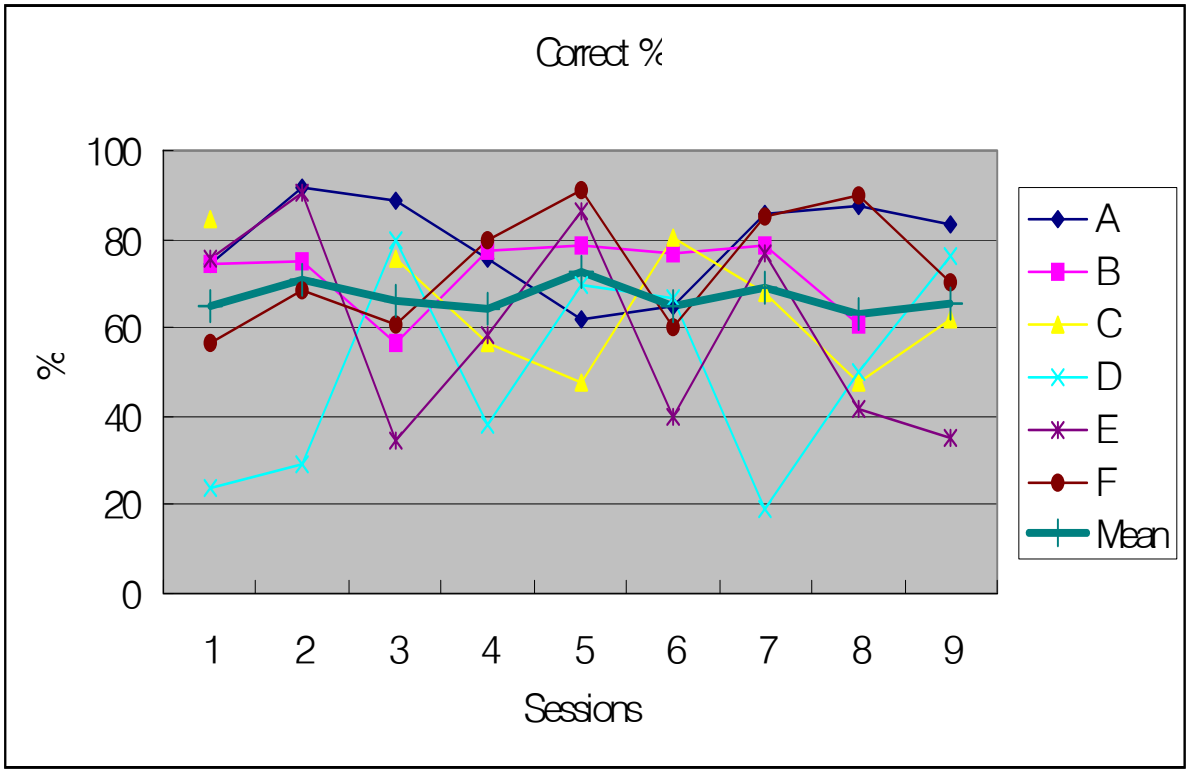
Participants: 10 children (Autism 5, MR + social problem 5)
8 male, 2 female, 7 years old, Mean IQ = 63.5, SMS = 71

Methods: teacher's and parent's questionnaires, psychological battery,
behavior & sensation measurement, etc.

Procedure: 1) Pre measurement
2) 10 sessions (sensory integrative intervention program,
social skill training program,
visual motor coordination program, total 30 min.)
3) Post measurement

Experimental design: Within-subject repeated measure ANOVA

Results of the Visual Motor Coordination program



## *Advantages & Disadvantages of Our System*

- Inexpensive : Computer, Beam projector, Web camera, Sensors
- Portable : easy to move and setup
- Useful for group activities
- Interesting and engaging
- Able to participate via the internet

- Low sensitivity of web camera
- Greater variety of software programs required

## *Coworkers*

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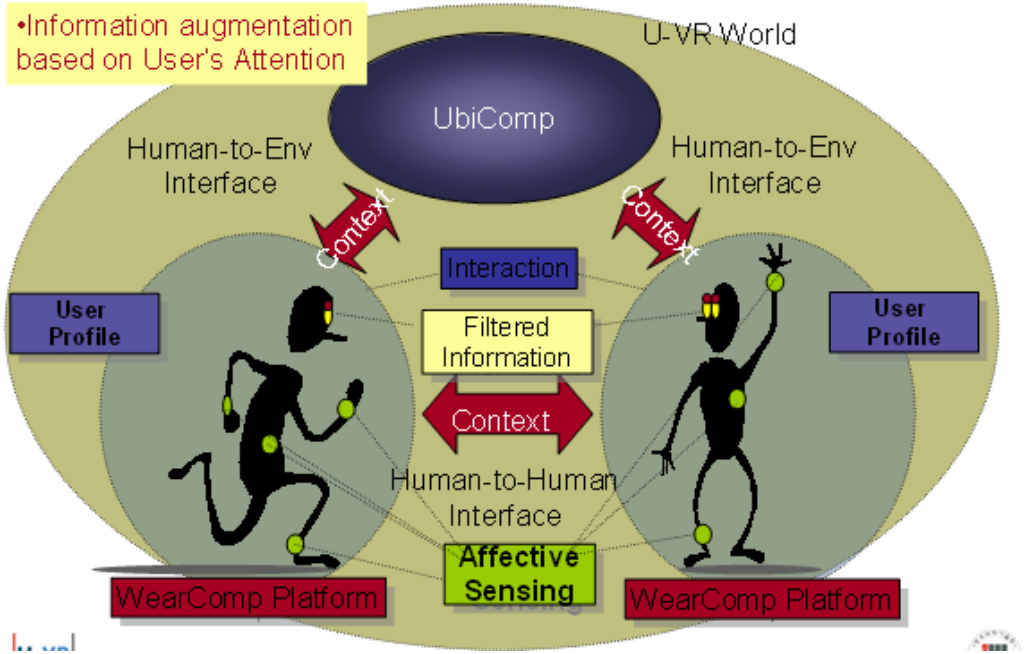
## *'The Disappearing Computer'*

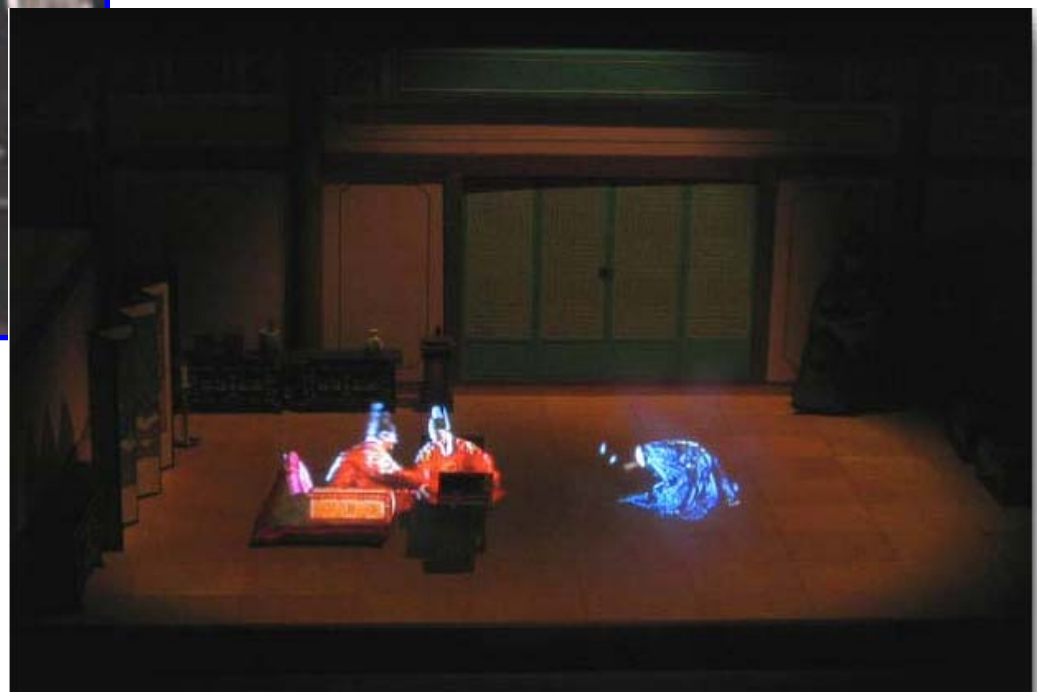
**"Computers will be all around us, essential to almost every part of our lives, but they will effectively have DISAPPEARED"**

***Bill Gates (The Economist, 2002. 12)***

*U-VR or AR*



**In the future, we predict new situations which combine human interaction with robots, virtual agents, or holograms.**



# Thank you for your attention.

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