

## Human Robot Interaction for Psychological Enrichment

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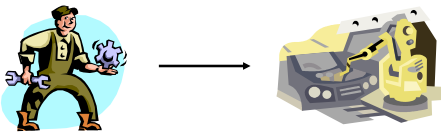
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## Contents

- ⌘ Robots and Intelligence
- ⌘ Objectivity and Subjectivity
- ⌘ Subjective Interpretation and Evaluation
- ⌘ History of Research and Development
- ⌘ Subjective Evaluation of Robots
- ⌘ Robot Therapy

## Industrial Robots

- ⌘ Provide Physical Labor to Humans
- ⌘ Automation



## Mental Commit Robot (Mental Calming Robot)

- ⌘ Impart a Positive **Mental Effect** on Humans, such as **Joy and Relaxation** through **Physical Interaction**
- ⌘ Create **Subjective Value** to Subject
- ⌘ For Children, Adults, Elderly People and Handicapped People

## Video: Mental Commit Robots



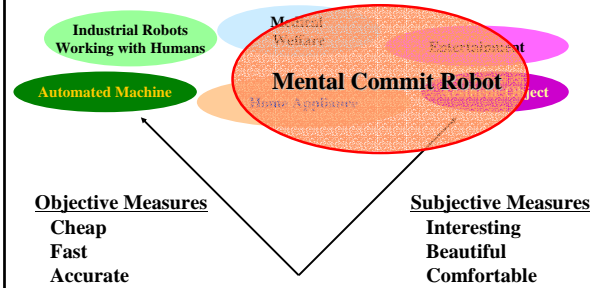
## In What Way are These Robots Intelligent

- ⌘ **Autonomy**: Can Create Goal and Motivation by Themselves
- ⌘ Seems to be Affectionate/Emotional
- ⌘ **Intelligence Exists in the View of the Observer**
- ⌘ **Interaction with Humans is the Key**

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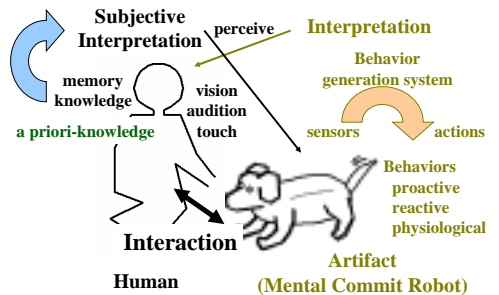
## Objectivity and Subjectivity



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## Subjective Interpretation and Evaluation



## Mechanical Animal Type Robots



Seal Robot



Cat Robot

## Animal Type Robots with Artificial Skin to Help Association



Seal Robot



Cat Robot

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## History of Research and Development

- ⌘ Investigation and Proposal (1993- )
- ⌘ Sensory System (1995- )
- ⌘ Behavior Generation Algorithms (1990- )
- ⌘ Psychological Experiment (1995-1997)
- ⌘ Animal Type Robots (1996- )
- ⌘ Subjective Evaluation of Robots (1998- )
- ⌘ Physiological and Psychological Experiment (2000- )
- ⌘ Robot Assisted Therapy/Activity (2000- )

## Relationship between Human and Animals



- ⌘ Pets are not always useful
- ⌘ 58% of households in US own more than one animal
- ⌘ Cat is the most, Dog is the second in US
- ⌘ Dog is the most, Cat is the second in Japan
- ⌘ Pet Market in US is about \$17 billion
- ⌘ Pet Market in Japan is about \$11 billion
- ⌘ Market of Industrial Robot in Japan is \$5 billion
- ⌘ Animal Assisted Therapy/Activity

(investigation in 1995)

## Psychological Experiment (at MIT AI Lab. 1995-97)



Picture of Dog Tail with One Degree of Freedom Tactile Sensor

Importance of Physical Interaction in Subjective Interpretation/Evaluation

## Four Categories of Appearance of Robot

- ⌘ Human
- ⌘ Familiar Animal (Cat, Dog, etc)
- ⌘ Non Familiar Animal (Seal, Penguin, Whale, etc)
- ⌘ New Character

## Dog Robot (at MIT AI Lab. 1995-97)



- ⌘ Sensor Integration
- ⌘ Behavior Generation

**Seal Robot Version 1  
(at MIT AI Lab. 1997-98)**



**Cat Robot: Tama  
(in Coop. with OMRON 1997- )**



**NeCoRo by OMRON  
(2001-2002)**



**Seal Robot Version 3: Paro  
(In Coop. with Microjennics Co. 1999- )**



**Model: Baby of Harp Seal**



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## Physical Interaction with Ordinary/Handicapped People

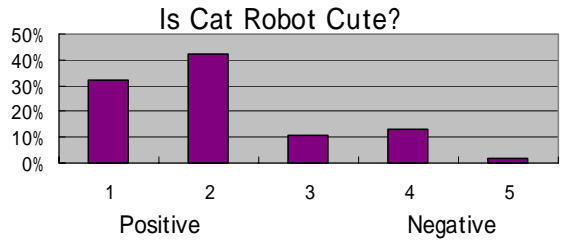


With Cat Robot

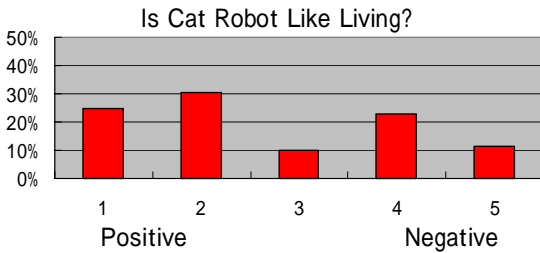


With Seal Robot

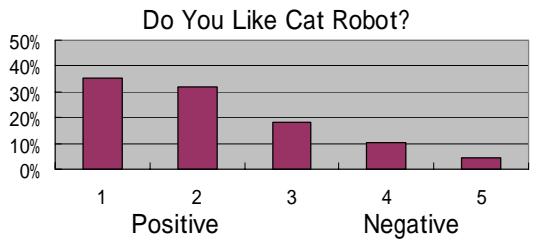
## Subjective Evaluation of Cat Robot 1 (88 subjects)



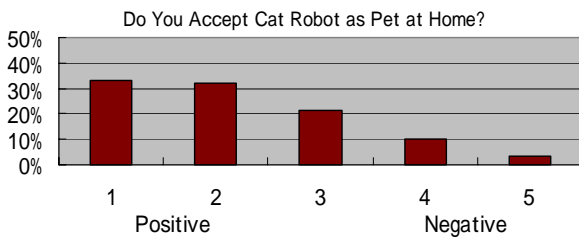
## Subjective Evaluation of Cat Robot 2



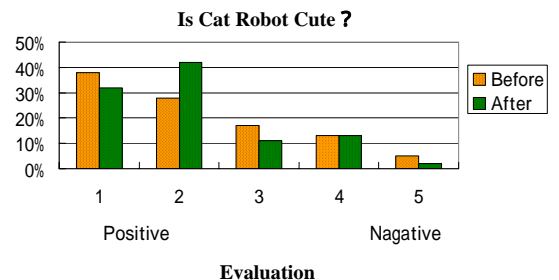
## Subjective Evaluation of Cat Robot 3



## Subjective Evaluation of Cat Robot 4

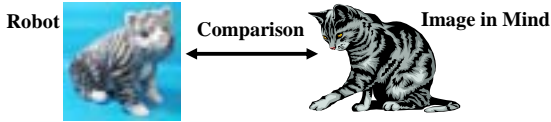


## Effect of Physical Interaction to Subjective Evaluation



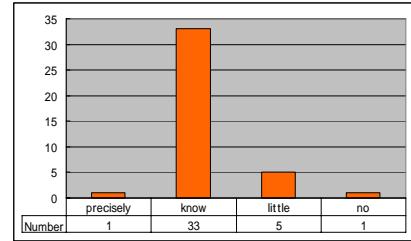
## Negative Comments to Cat Robot

- ⌘ Subjects Compared Cat Robot with their Image of Real Cat in their Mind
- ⌘ "Body was Hard"
- ⌘ "Reaction was Different from Expectation"
- ⌘ etc



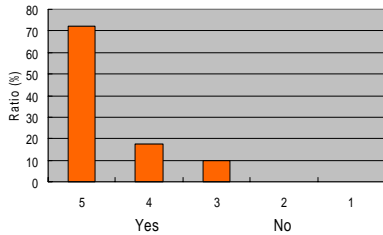
## Subjective Evaluation of Seal Robot 1 (40 subjects)

Do you know Seal?



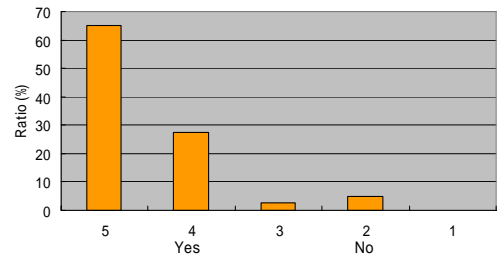
## Subjective Evaluation of Seal Robot 2

Do you want to touch?



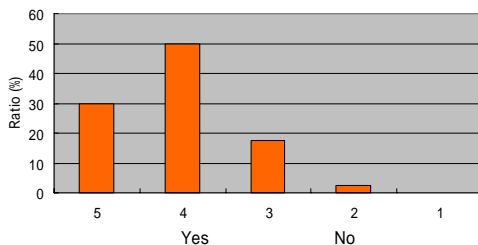
## Subjective Evaluation of Seal Robot 3

Is Seal Robot Cute?



## Subjective Evaluation of Seal Robot 4

Are you comfortable with Seal Robot?



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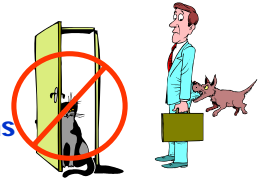
## Animal Assisted Therapy

- ⌘ Psychological Merits
- ⌘ Physiological Merits
- ⌘ Social Merits



## Problems of Owning Animals

- ⌘ Allergies
- ⌘ Bites
- ⌘ Infection
- ⌘ Housing Regulations

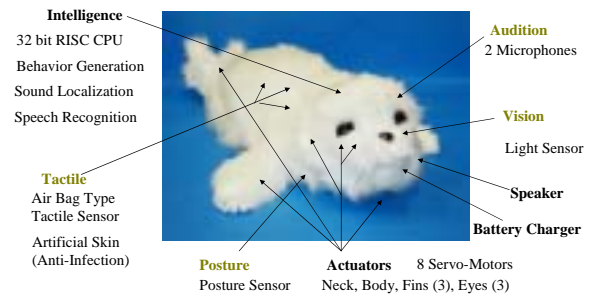


- ⌘ Potential Market for Companion Robots

## Robot Assisted Therapy (at a Hospital)

- ⌘ Children (0-15 years old)
- ⌘ Short-term Inpatient (A few days/weeks)
- ⌘ Long-term Inpatient (A few years)
- ⌘ Three Times of Interaction in a Day
- ⌘ Results: Psychological and Social Effects
- ⌘ Physiological Effects are under Investigation

## Specification of Seal Robot (Version 5)



## Video: Robot Therapy (Jan. 6, 2001) (Japanese TV News: NHK News 7)



## Interaction between Children and Robots in Robot Assisted Therapy



## Subjective Evaluation with Face Scale: 1=happy; 20=sad

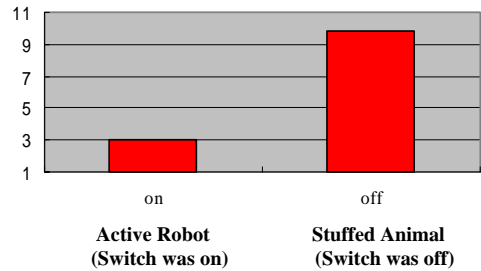


Face Scale contains 20 drawings of a single face, arranged in serial order by rows. They are arranged in decreasing order of mood and numbered from 1 to 20, with 1 representing the most positive mood and 20 representing the most negative mood.

Lorish and Maisiak (1986)

## Results of Subjective Evaluation with Face Scales

Average Face Scale Scores



## Robot Assisted Activity (at a Day Service Center)

⌘ Elderly People (26: 73-93 years old)

⌘ Three Times in a Week

⌘ Five Weeks

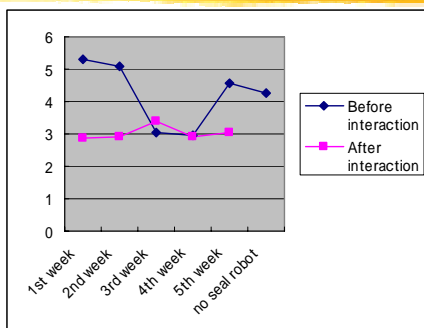
⌘ Investigation

- ⌘ Psychological Effect: Interview (POMS)
- ⌘ Social Effect: Observation
- ⌘ Physiological Effect: Stress Reaction in Urinary Test

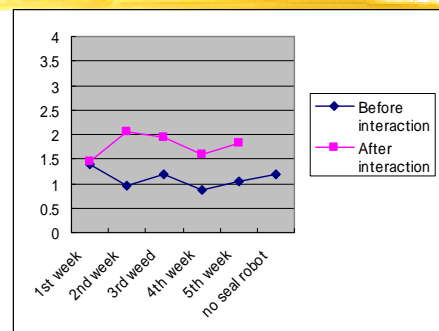
## Interaction between Robot and Elderly (video)



## Results of Average Face Scale Scores of Elderly



## Comparison of Vigor of Elderly between Before and After Interaction





## Effects

### ⌘ Effects to Elderly

#### ☒ Psychological Effects:

☒ Improve mood

☒ Increase of Vigor

#### ☒ Physiological Effects:

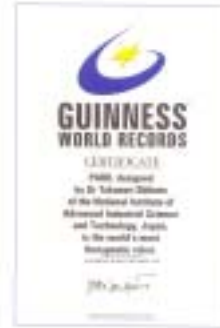
☒ Decrease of Stress (by Urinary Test)

#### ☒ Social Effects

### ⌘ Effects to Nurses

☒ Decrease of Burn Out

## Guinness World Records (Feb. 2002) Paro: Most Therapeutic Robot



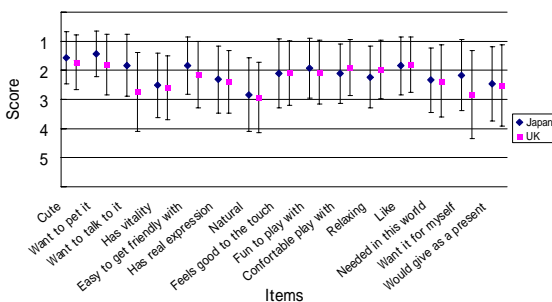
## RAA at Health Service Facility for the Aged (video)



## (Organized by JETRO): PARO (video)



## Comparison of Subjective Evaluation Between JP and UK



## Science Museum, London, UK (Organized by JETRO): AIBO (video)



PARO in UAE  
(with the Prince of UAE)



Baby Harp Seal at Il de la Madeleine,  
Canada (video)



PARO in the Prime Minister's House  
of Japan (Jan. 28, 2003) (video)



## Conclusions

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