



# **INTRODUCTION TO HRI:**

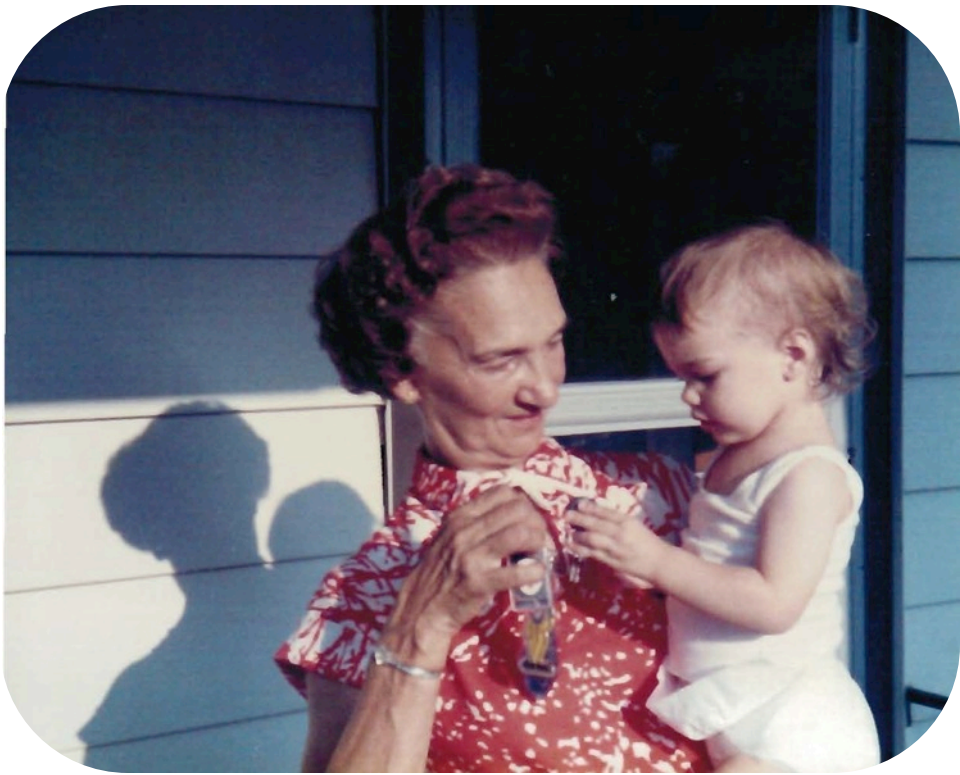
## **ASSISTIVE TECHNOLOGY FOR OLDER ADULTS**

Jenay M. Beer

*Advance Robotics Course, University of South Carolina*

September 15, 2014

# Aging in place



*How can I help older adults?*



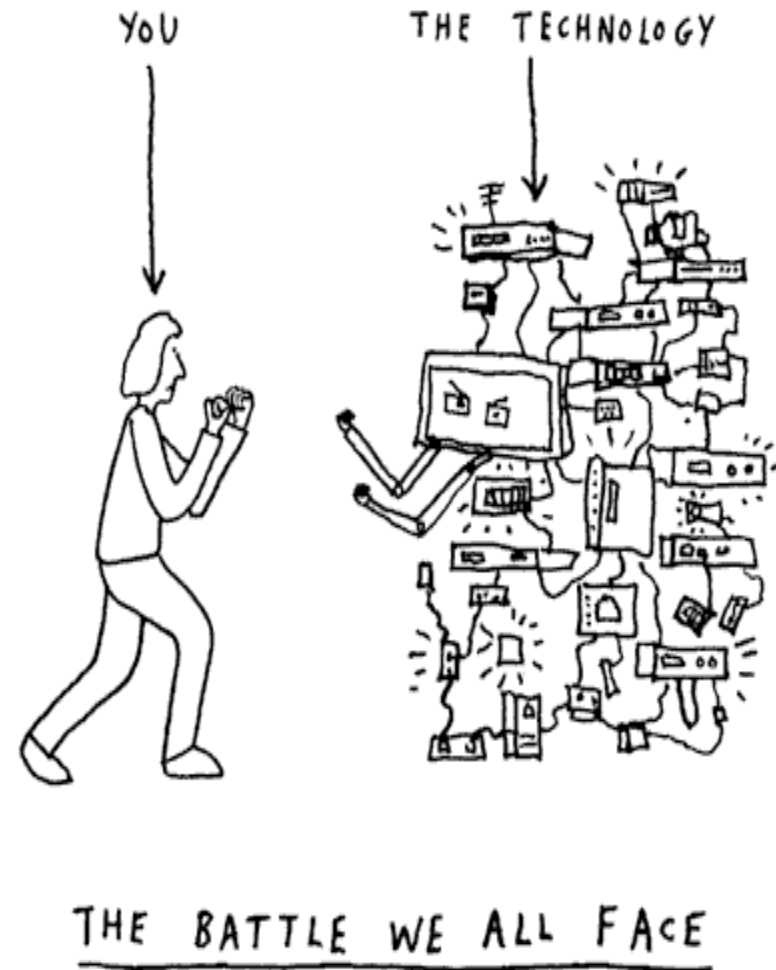
UNIVERSITY OF  
**SOUTH CAROLINA**



- Joint appointment
  - Department of Computer Science and Engineering
  - College of Social Work
  - My Degree: Engineering Psychology
- Associate Director for Usability, SeniorSMART

# What is human factors?

*“The study of human beings and their interactions with products, environments, and equipment in performing tasks and activities.” (Czaja, 1997)*





# Assistive Robotics and Technology Lab



User Experience

Usability

Applied Experimental Psychology

Human Factors

Engineering Psychology

Ergonomics

User - Centered Design

Human-Computer Interaction





# Human-Robot Interaction (HRI)

*“dedicated to understanding, designing, and evaluating robotic systems for use by or with humans”* (Goodrich & Schultz, 2007, p. 204)

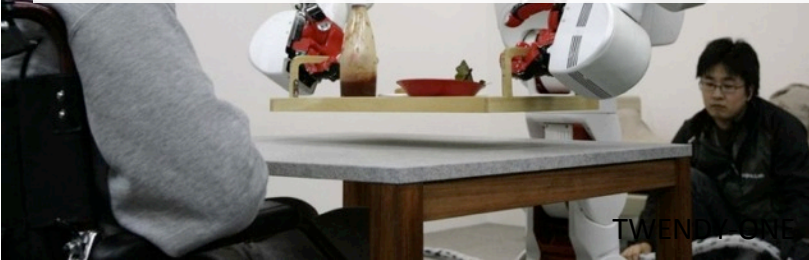




Ri-Man



# Why aren't these robots commonplace?



Willow Garage



MySpoon



Rodney Brook's

# **THE FOUR CHALLENGES IN ROBOTICS**

NPR Interview 2013

# Vision of a 2 year old



# Language of a 4 year old

## Mobile Robot Language

### Control Systems

<b>Primary Driver</b>
GoDirection
ReleaseCoin

<b>Collision Evader</b>
Idle
Backup
GoDirection

<b>Lost Recovery</b>
Idle
Panic

### Navigation Software

<b>NAV</b>
GoDirection
Backup

<b>Straight Line Driver</b>
Begin
Backup
Stop

<b>Events</b>
NavTimeout
NewPosition

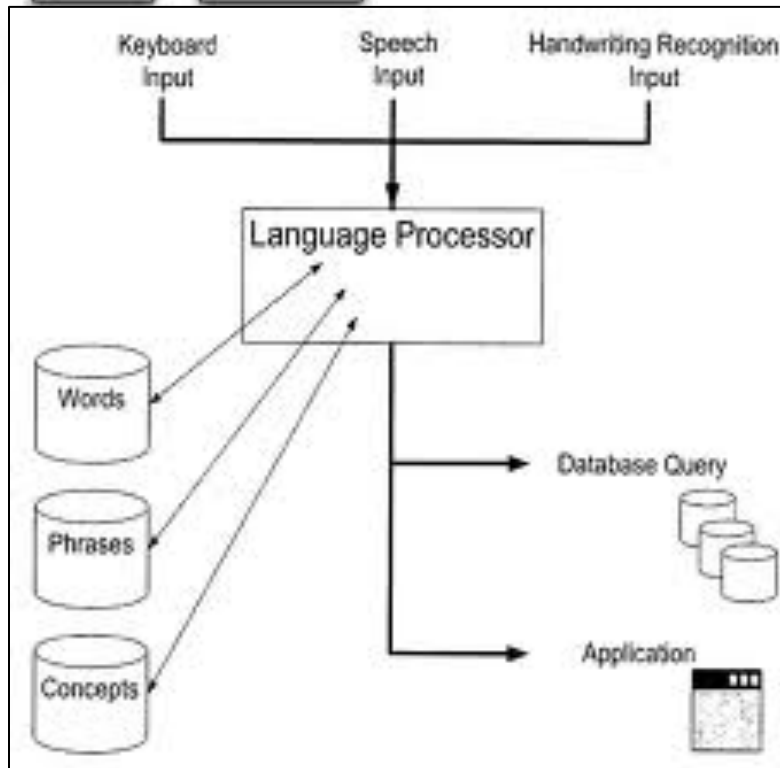
### Input Hardware

<b>Type Sensor</b>
PL
00
01
10
11

<b>Bumper Sensor</b>
0
1

### Output Hardware

<b>Motor</b>
Stop
Fwd
Back
LeftTurn
BackLeftTurn
RightTurn
BackRightTurn
Turn180
ArcLeft
ArcRight



# Dexterity of a 6 year old





# Social ability of an 8 year old



# **THE FOUR CHALLENGES IN HRI**

## **CHALLENGE ONE: HOME**

# Willow Garage's PR2



- 7 DOF Arms, 1 DOF grippers
- Counter balanced arms with 4lb payload
- Telescoping spine 4'4-5'5
- RFID antennas
- Base size = most wheelchairs
- Head sensors
  - Color, wide-angle, narrow-angle, and LED texture projector cameras
  - Laser scanner (above shoulders)
  - Xbox Kinect



Autonomous RFID guided delivery created by Dr. Travis Deyle, Healthcare Robotics Laboratory

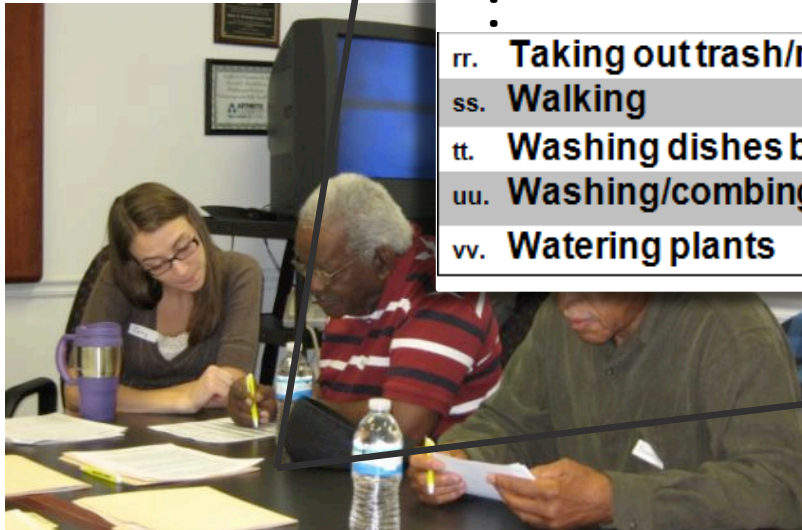
Beer, Smarr, Chen, Prakash, Mitzner, Kemp, & Rogers, (2012) HRI ;  
Beer, Prakash, Smarr, Mitzner, Kemp & Rogers (2012) HFES



*“Imagine you need assistance in everyday life with various tasks”*

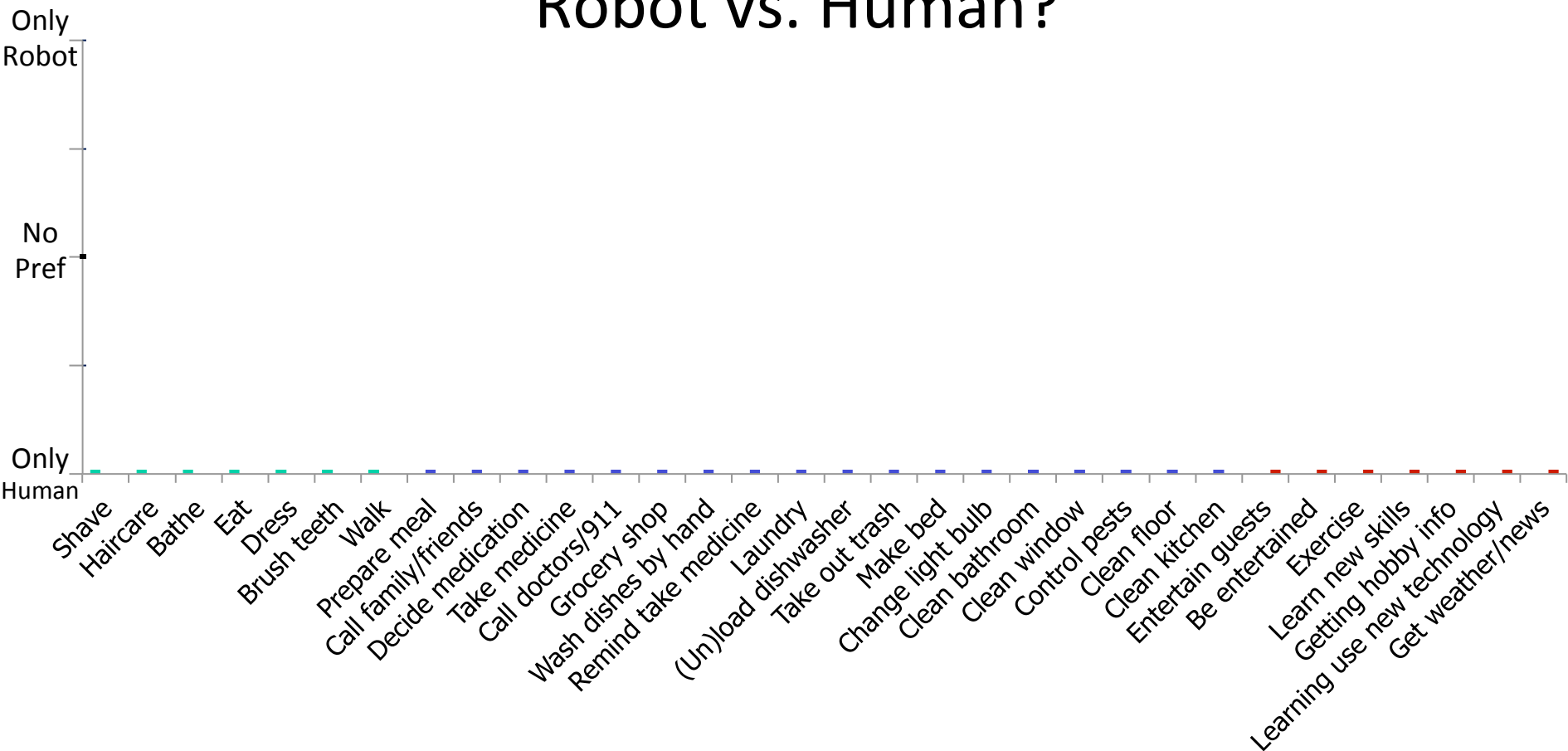
N=21  
 Independent living  
 Generally healthy  
 Aged 64-93, M = 80 ± 7.2

If I needed assistance with...	If I needed assistance, I would prefer help from...				
	Only a human <sub>1</sub>	Prefer a human <sub>2</sub>	No Preference	Prefer a robot <sub>4</sub>	Only a robot <sub>5</sub>
a. Bathing	1	2	3	4	5
b. Being entertained (e.g., playing games, dancing)	1	2	3	4	5
c. Being reminded of appointments	1	2	3	4	5
⋮					
rr. Taking out trash/recyclables	1	2	3	4	5
ss. Walking	1	2	3	4	5
tt. Washing dishes by hand	1	2	3	4	5
uu. Washing/combing hair	1	2	3	4	5
vv. Watering plants	1	2	3	4	5

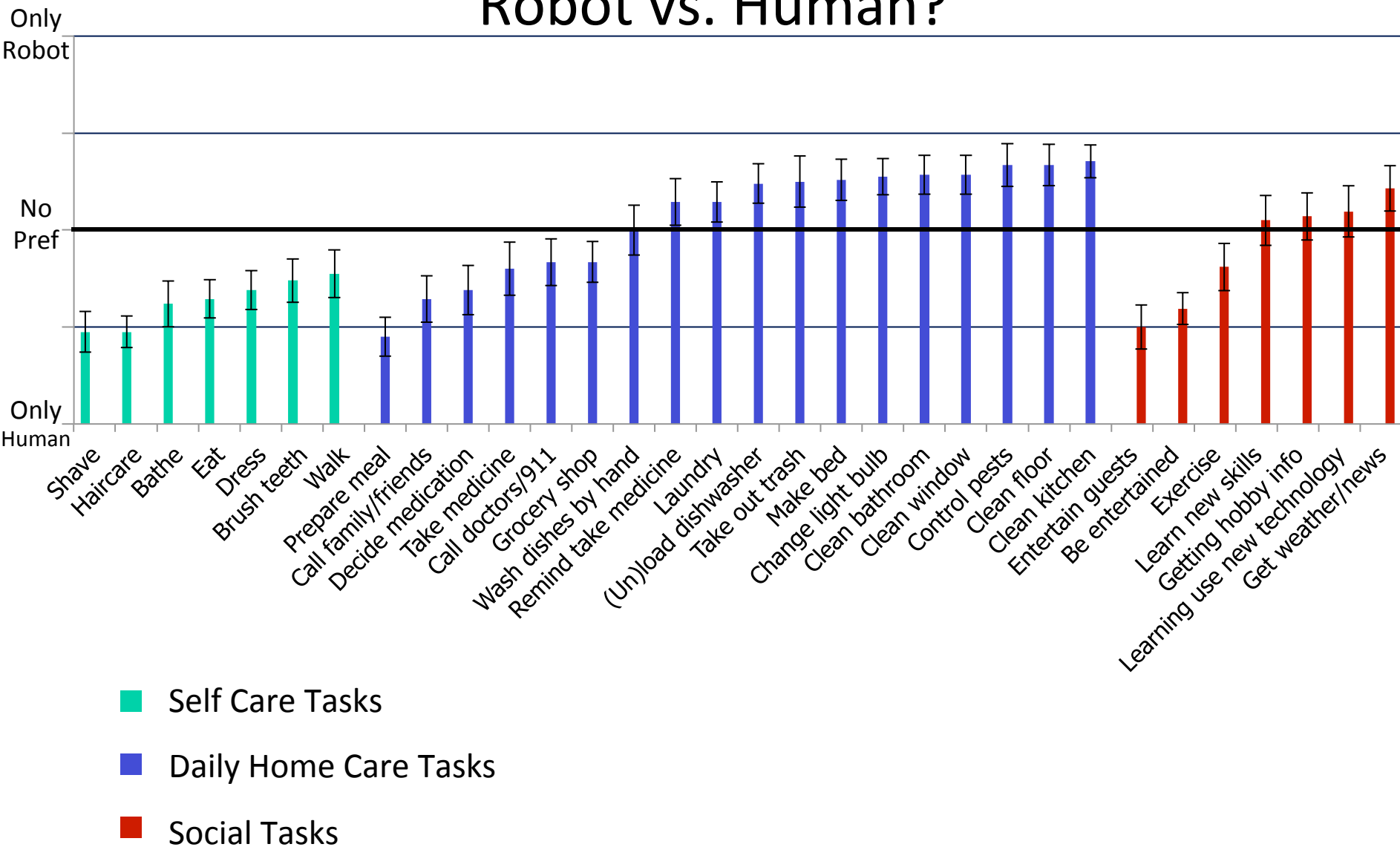


Preferred assistance from a robot for **28 of 48 tasks**

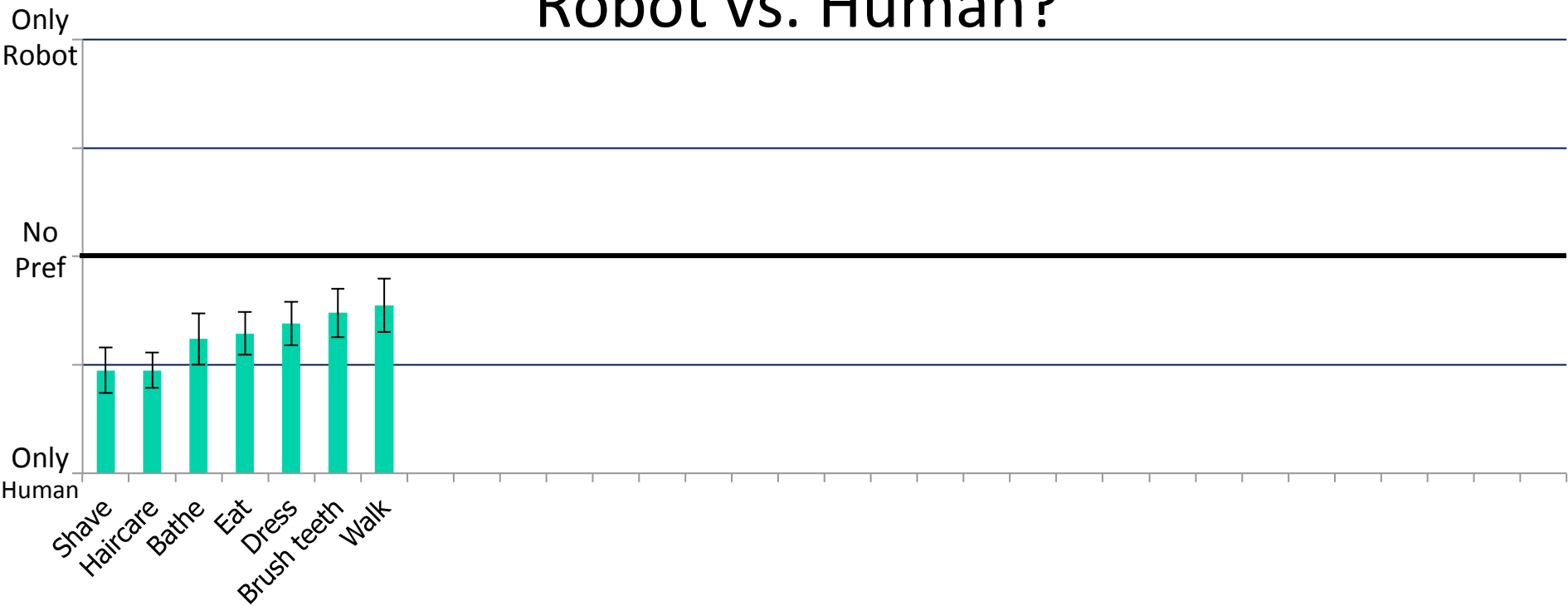
# Assistance Preference – Robot vs. Human?



# Assistance Preference – Robot vs. Human?



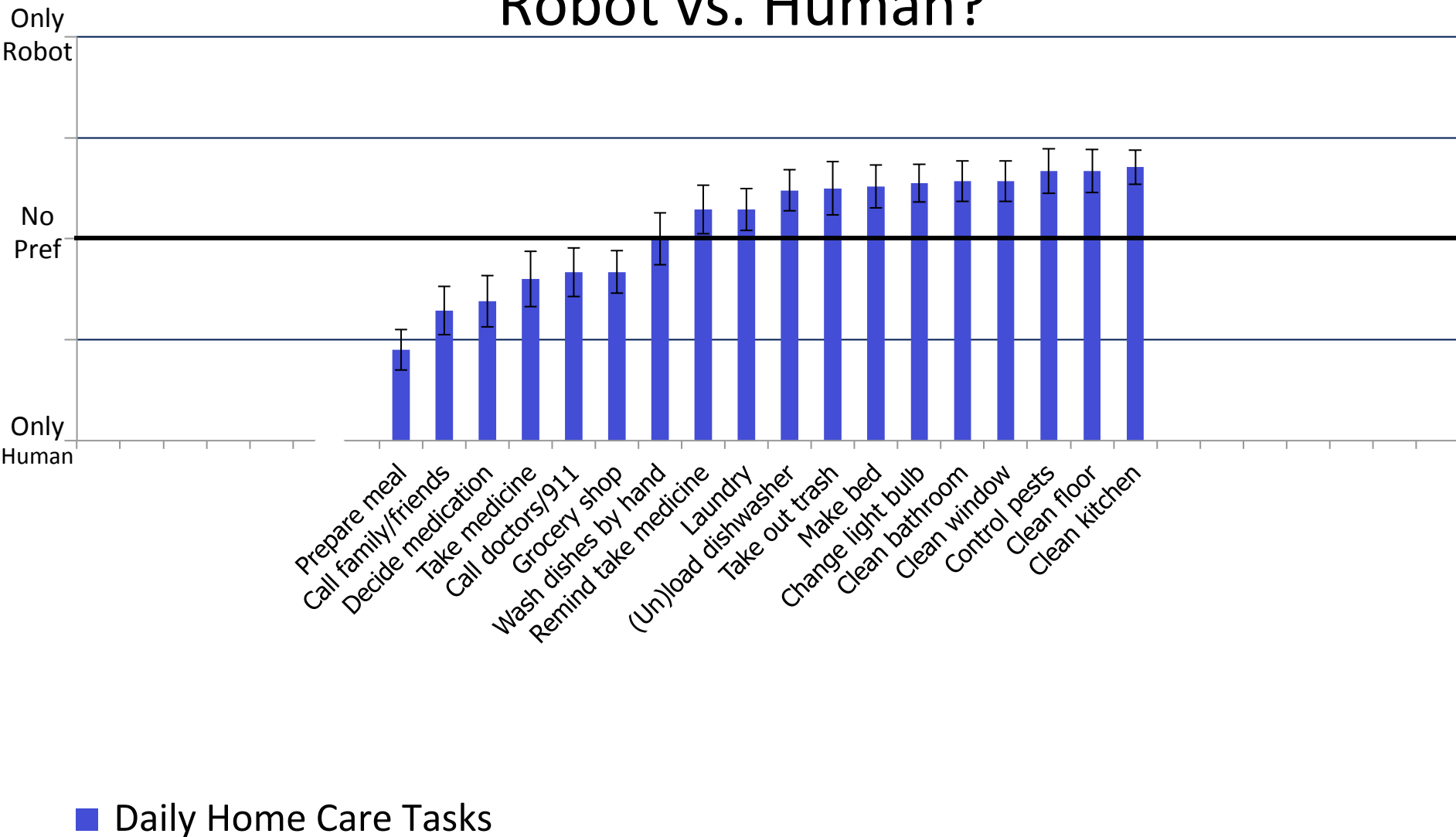
# Assistance Preference – Robot vs. Human?



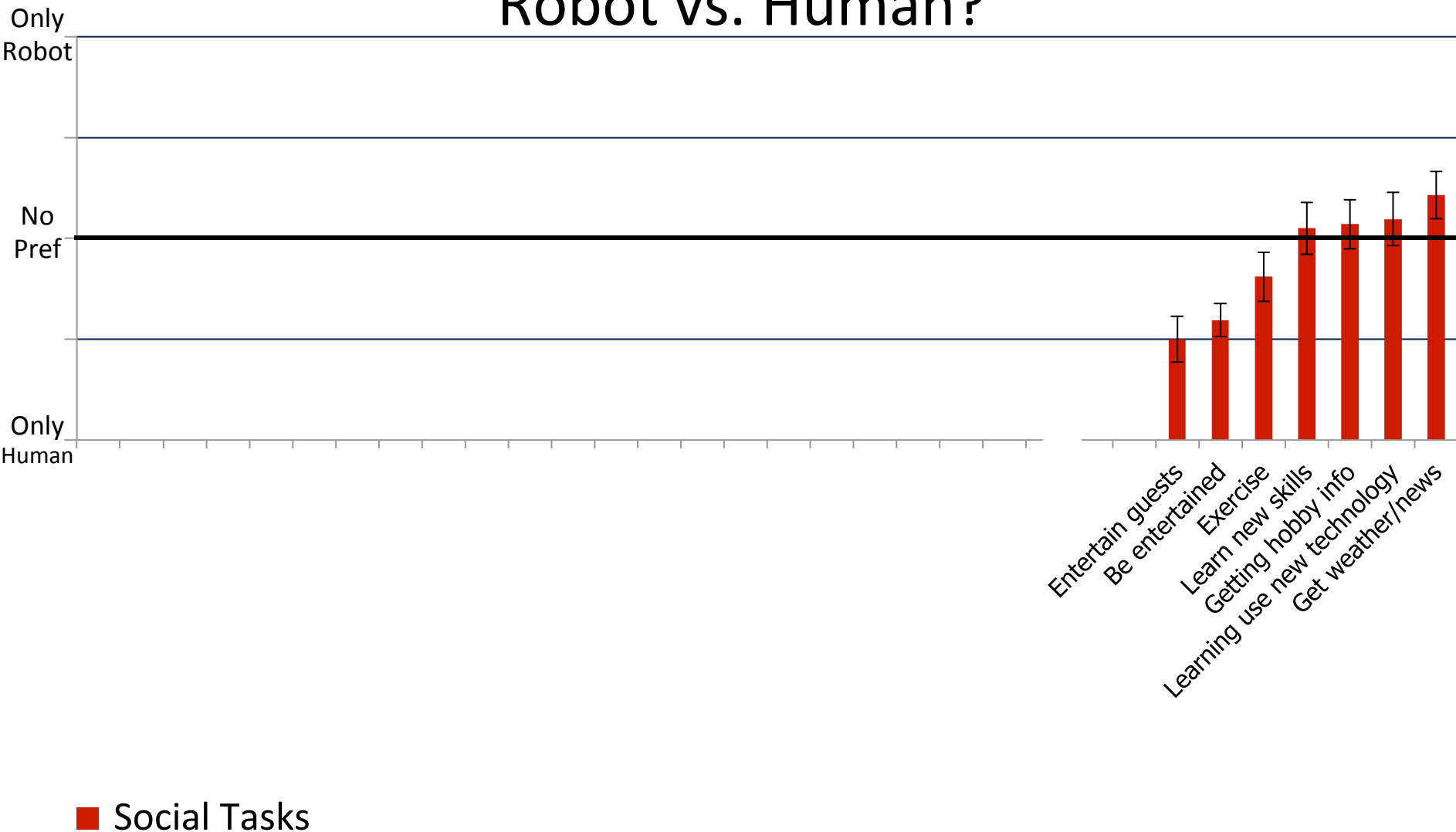
■ Self Care Tasks

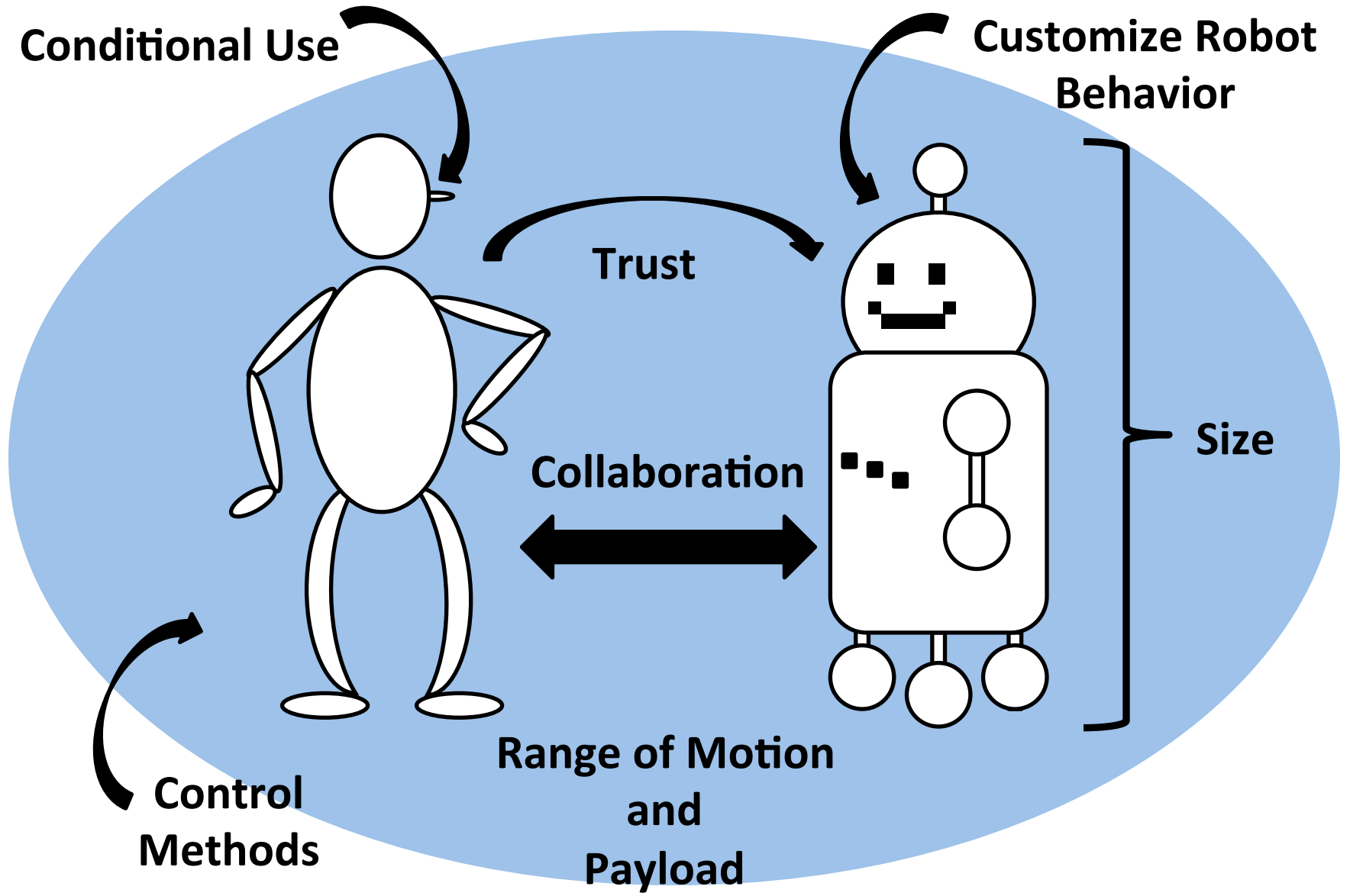


# Assistance Preference – Robot vs. Human?



# Assistance Preference – Robot vs. Human?





# Acceptance: Critical Next Steps

- Long term use
  - Novelty effect?
- Integration to home
- Appearance, size
- Allocation of function (Collaboration)



**THE FOUR CHALLENGES IN HRI**  
**CHALLENGE TWO: MONITORING**



# PREVENTING FALLS STEP BY STEP

Among older adults, falls are a leading cause for hospitalization and emergency care. Falls can lead to potentially severe injuries such as hip fractures and head traumas, and can even increase the risk of early death. During Falls Prevention Awareness Week, Amedisys® Home Health and Hospice offers the following tips to reduce the risk of falling so seniors can live healthier, more independent lives.

## IN THE HOME:

Know about any side-effects of medication that could potentially lead to a fall.

Use non-slip rubber mats in the bathtub and shower.

Keep your home well-lit, placing lights in hallways, stairwells, and bathrooms.

Clean up spills once they happen.

Use handrails on the stairway and in the bathroom.

Clear walkways of clutter, electrical cords, etc.

Get rid of throw rugs or use double-sided tape to secure them.

## YOURSELF:

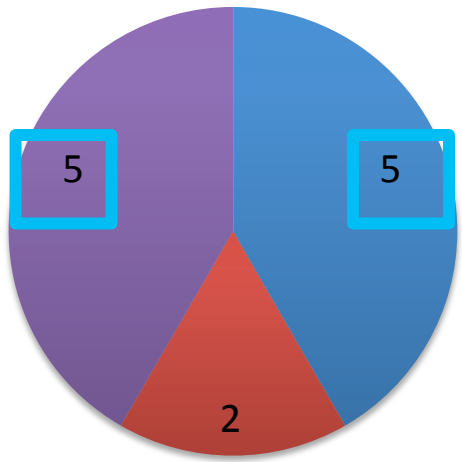
Exercise to improve strength, balance, and coordination. Always check with your doctor before starting a new exercise routine.

Wear sturdy shoes and/or non-skid socks.

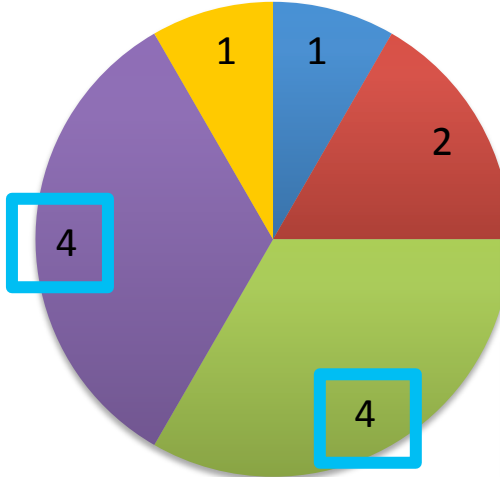
If you live in a region that gets wintery weather, consider putting special cleats on your shoes to prevent you for slipping on the snow and ice.

# Monitoring

### Mobile Older Adults



### Older Adults with Mobility Loss

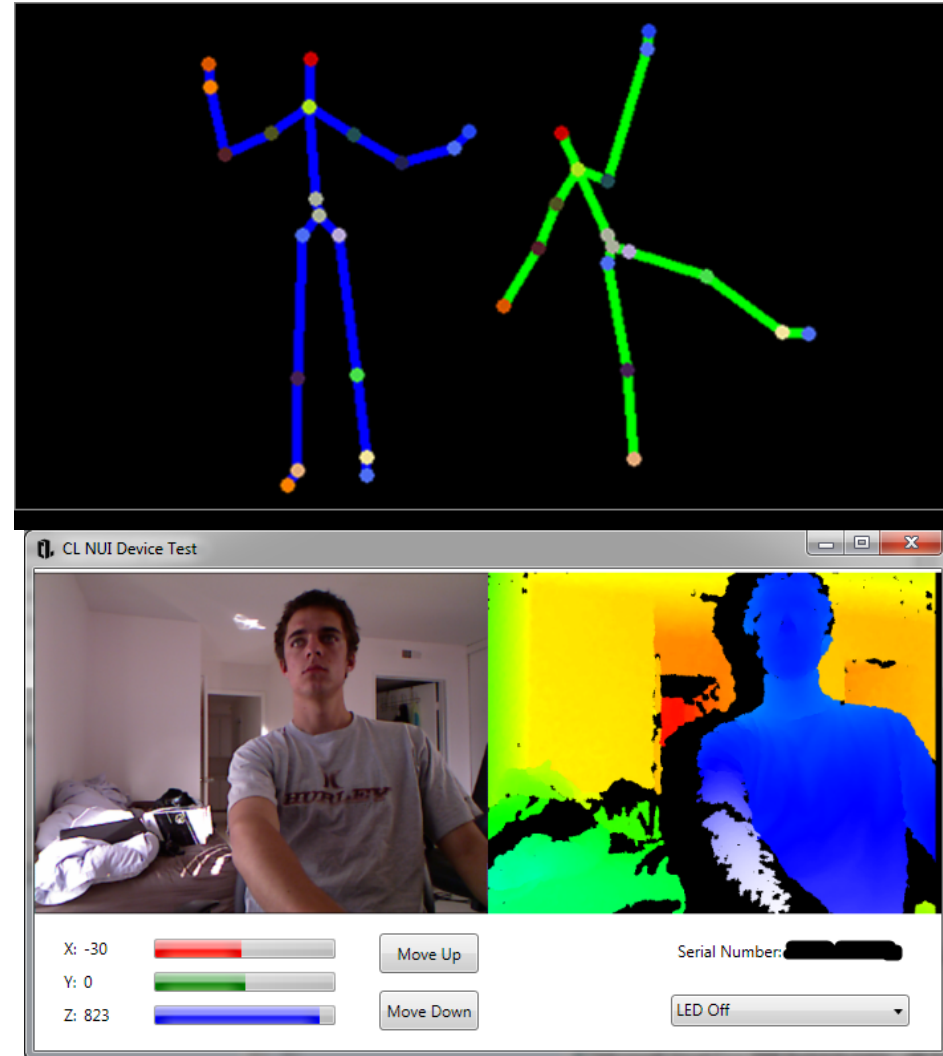


- No robot assistance
- I command/control the robot
- Someone else commands/controls the robot
- The robot commands/controls itself
- Mixed Answer

*"If there's a robot that can do that kind of stuff, that's good because it takes some of the pressure off of me to remember all of that thing because he knows what the normal is. It's doing good and not so good."*

# Monitoring: Barriers to use

- Privacy
- Use of information
- Reliability
- Perceptions of reliability



Caine, K. E., Šabanović, S., & Carter, M. E. (2012)  
Demiris, Hensel, Skubic, & Rantz (2008)

**THE FOUR CHALLENGES IN HRI**  
**CHALLENGE THREE: TELEPRESENCE**

# Mobile remote presence for older adults

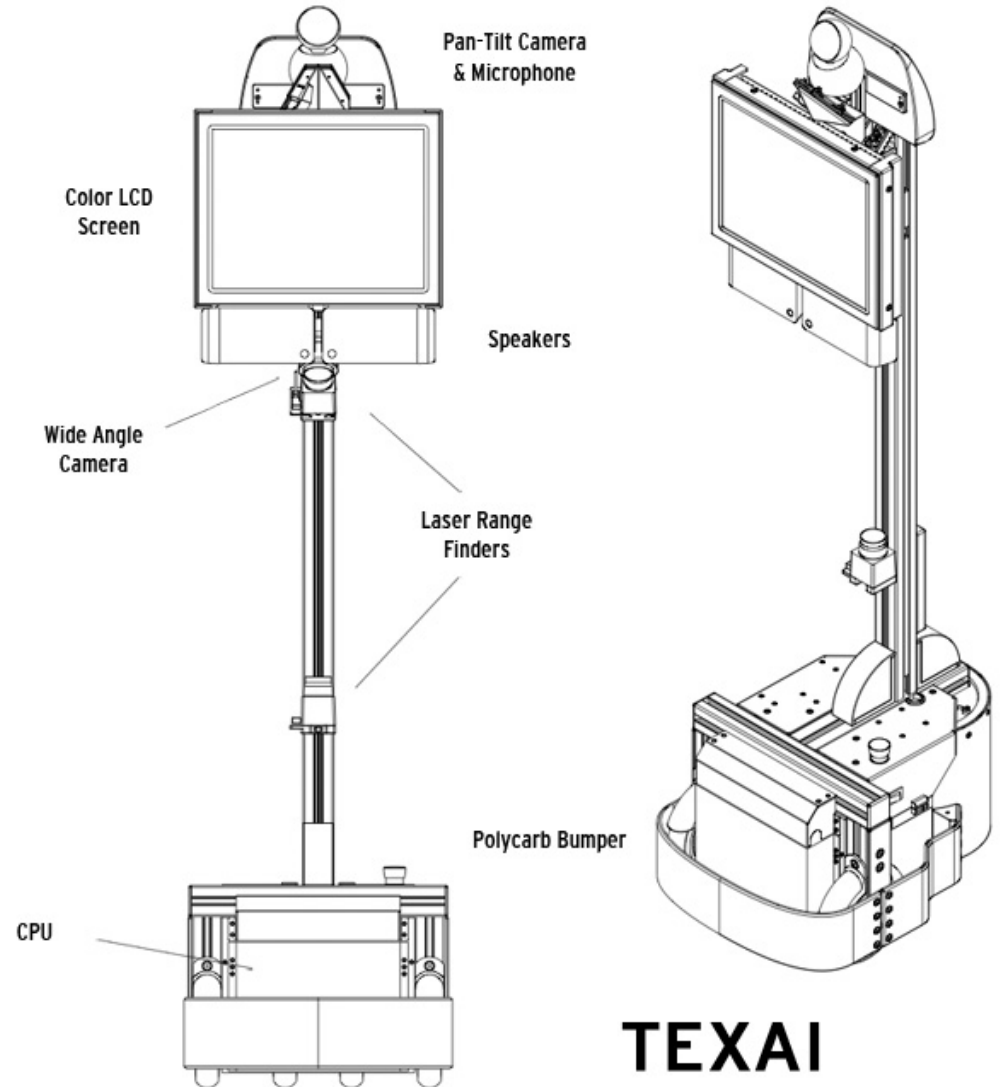
- Many applications involve robots supporting activities of daily living (Pollack et al., 2002)
- Another approach uses robots to enable social interaction *between people*
  - Social communication helps older adults age in place (Rogers, Meyer, Walker, & Fisk, 1998)





# Telepresence systems

- Skype on wheels
- “Remote Presence”
- Pilot via web interface



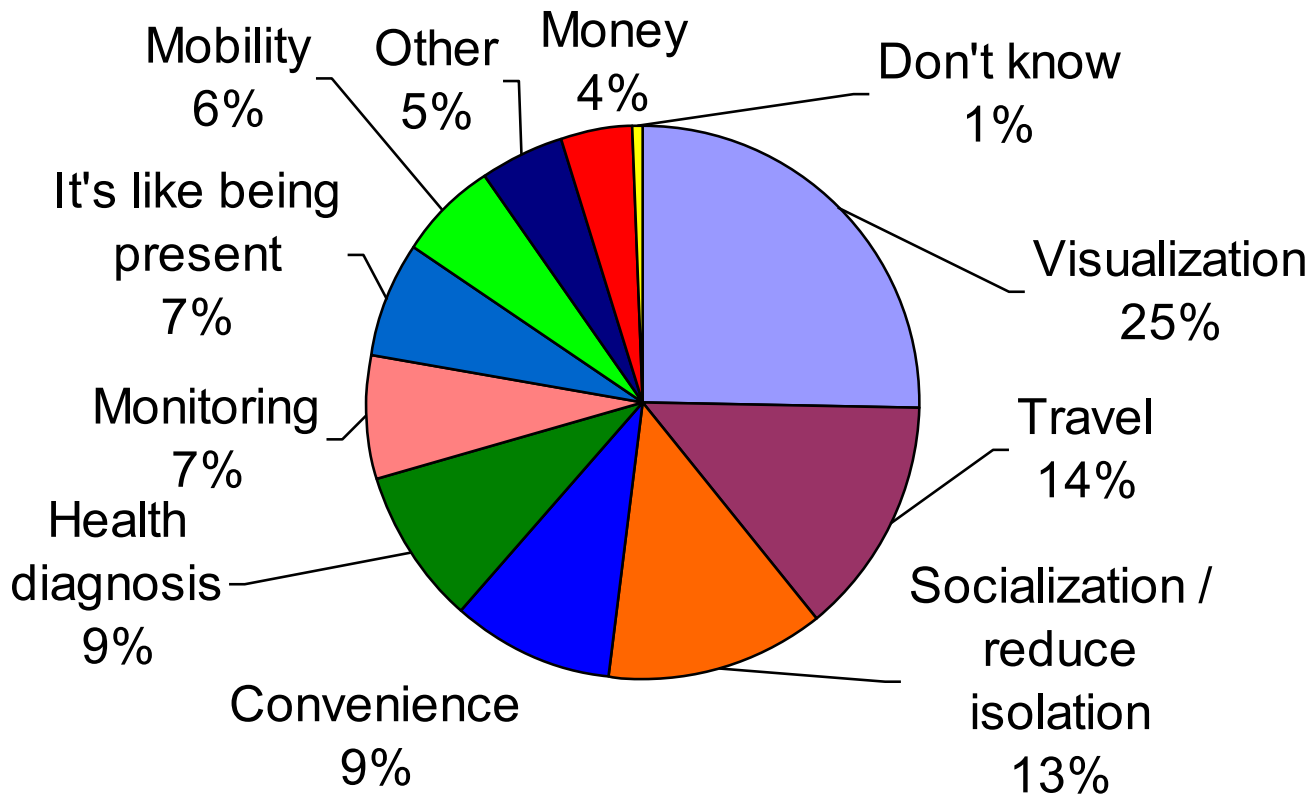
# Benefits vs. Concerns

- More benefits (n=174) vs. concerns (n=124)
  - $\chi^2 = 15.4, p < .0001$
- More concerns as local user (n=75) vs. pilot user (n=49)
  - $\chi^2 = 5.45, p < .02$

*“I would prefer to control the robot. Now that's me, because I want to be in control of what's happening. It was neat that he came and visited me. That was nice. But I have no control over that, ... ”*

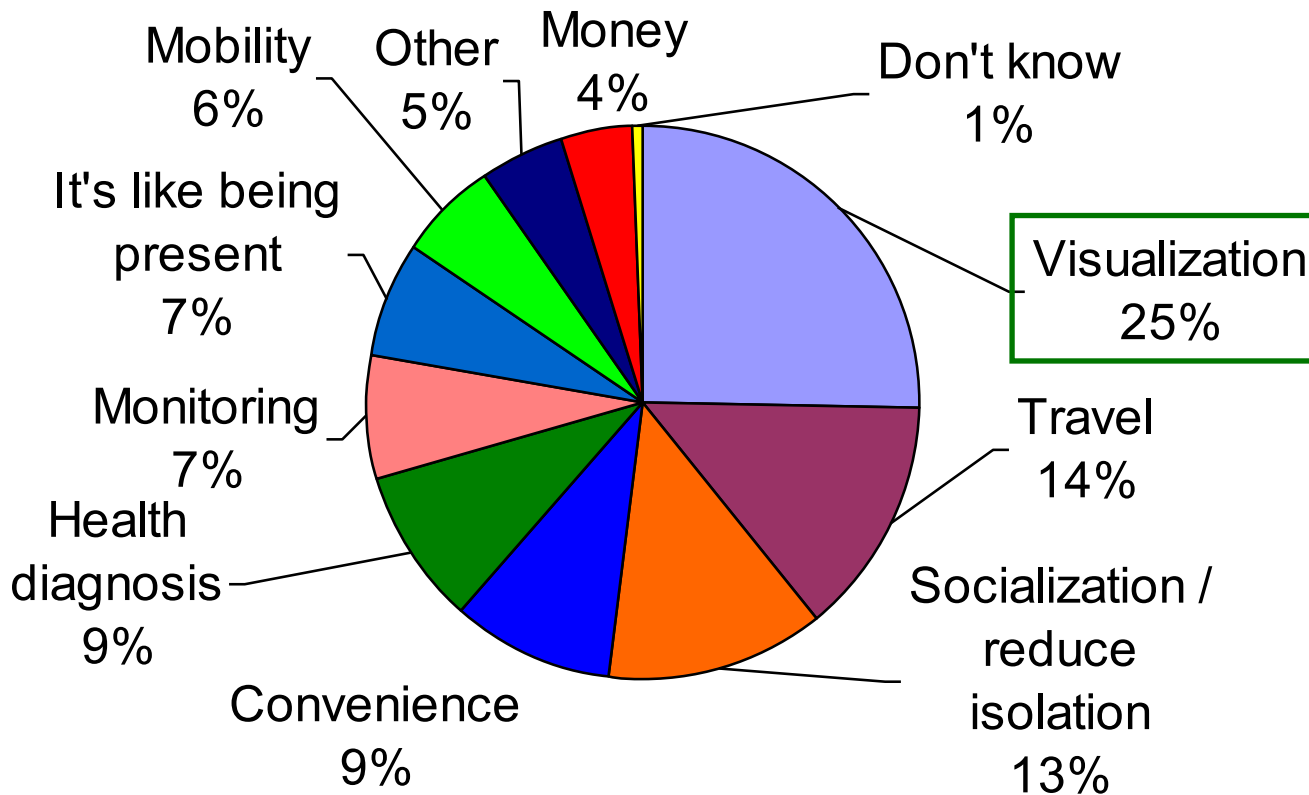
12 older adults ( $M = 73.38, SD = 7.38$ ), 5 males and 7 females

# Overall Benefits (times mentioned)



12 older adults ( $M = 73.38$ ,  $SD = 7.38$ ), 5 males and 7 females

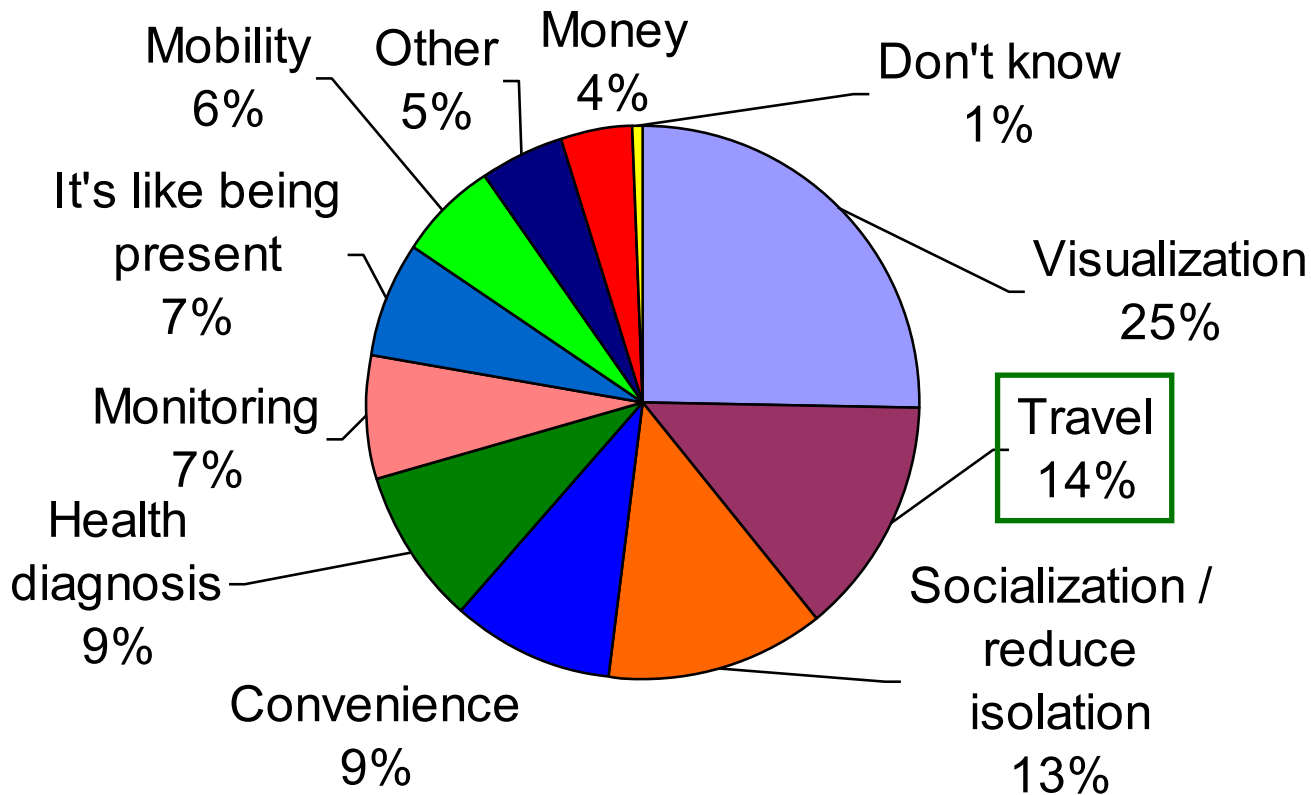
# Overall Benefits (times mentioned)



*“...there are situations when it's important to look at people's faces when you're presenting ideas to see what the feedback is... It adds another dimension to just the linguistic exchange.”*

12 older adults ( $M = 73.38$ ,  $SD = 7.38$ ), 5 males and 7 females

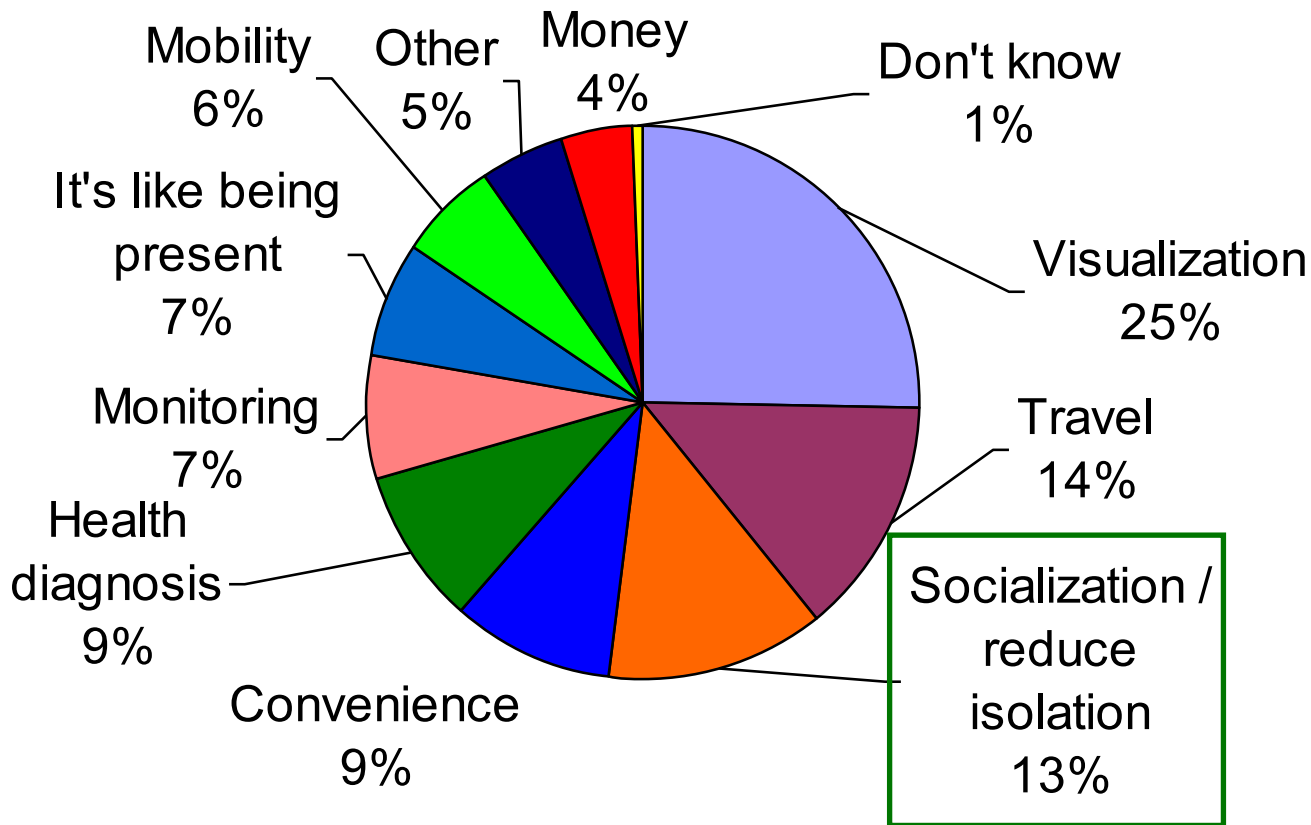
# Overall Benefits (times mentioned)



*"... once you can't drive ... it would be fun to be able to have your robot take you. Then you're not stuck. You're more and more isolated, the older you get and the less you can do, such as if you can't drive."*

12 older adults ( $M = 73.38$ ,  $SD = 7.38$ ), 5 males and 7 females

# Overall Benefits (times mentioned)

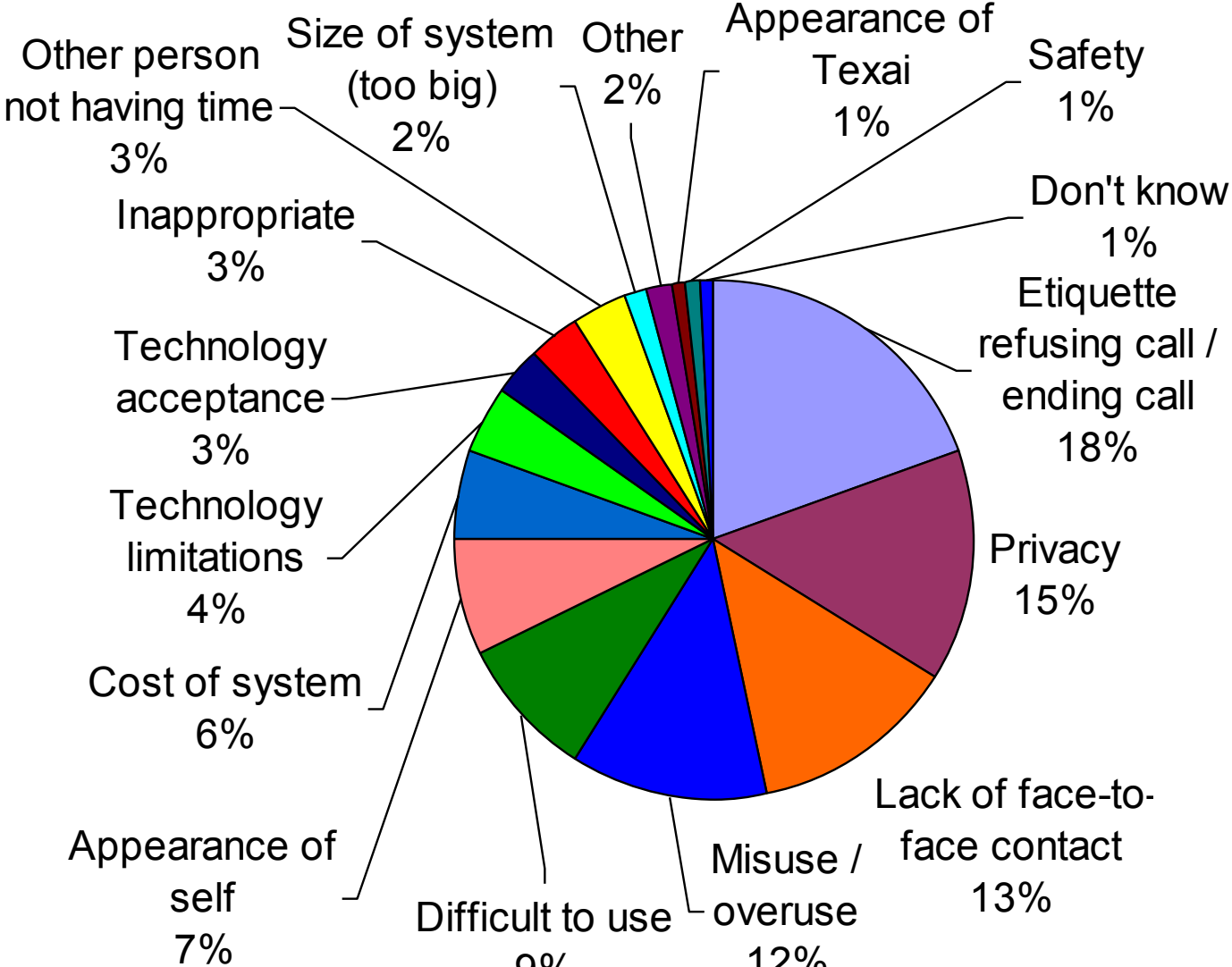


*"... they have to be there for weeks, they don't get to see anybody, so I think it would be very helpful to an inmate, let us say or a patient, not an inmate, to have a visitor. Because I know my friend became very depressed when she was contained in this so called upscale facility, very depressed."*

12 older adults ( $M = 73.38$ ,  $SD = 7.38$ ), 5 males and 7 females

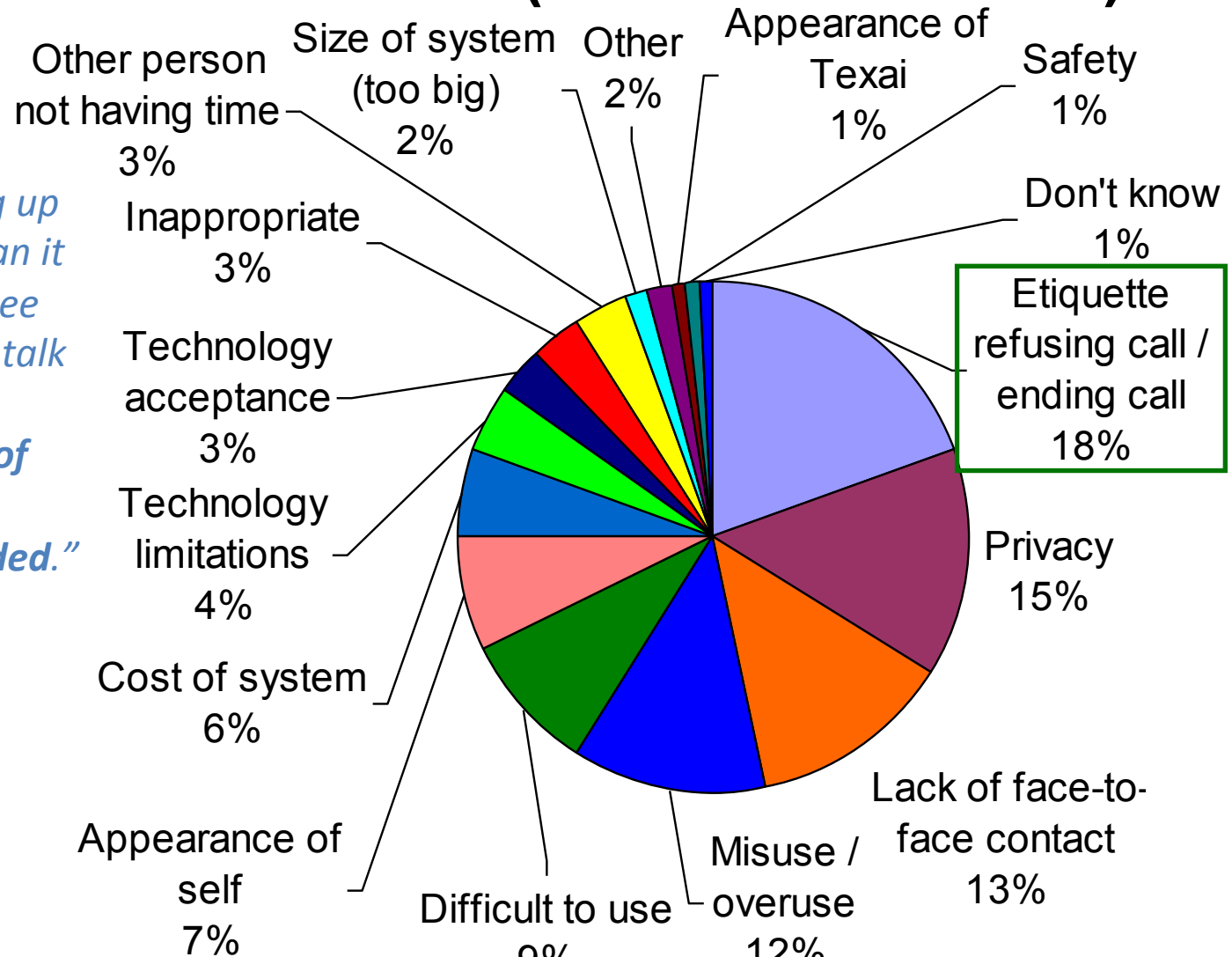


# Overall Concerns (times mentioned)



12 older adults ( $M = 73.38$ ,  $SD = 7.38$ ), 5 males and 7 females

# Overall Concerns (times mentioned)

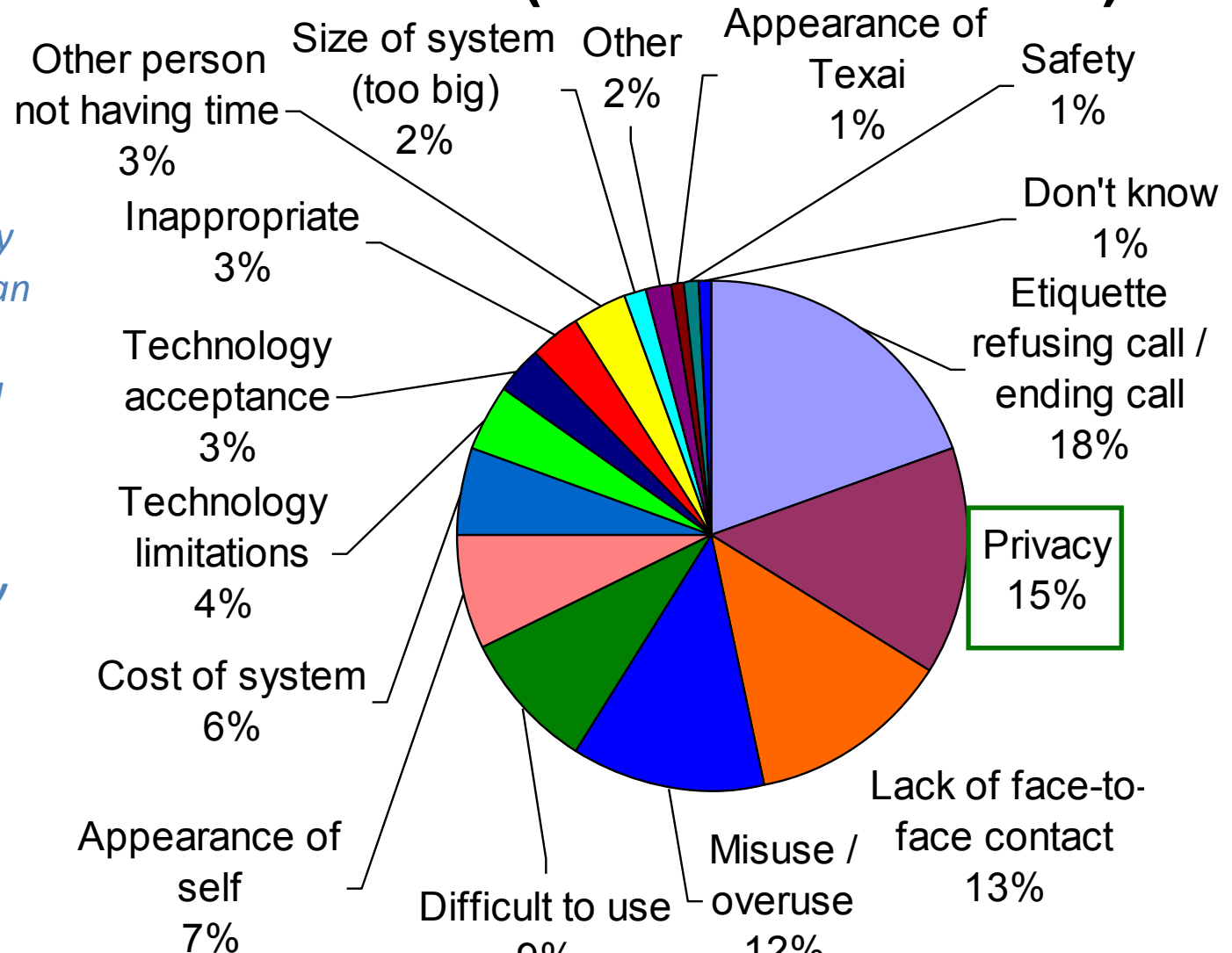


*"It's a lot easier to hang up on somebody gently than it would be if they could see that you didn't want to talk to them...we'd have to learn a whole new set of skills on how to keep a distance when it's needed."*

12 older adults ( $M = 73.38$ ,  $SD = 7.38$ ), 5 males and 7 females

# Overall Concerns (times mentioned)

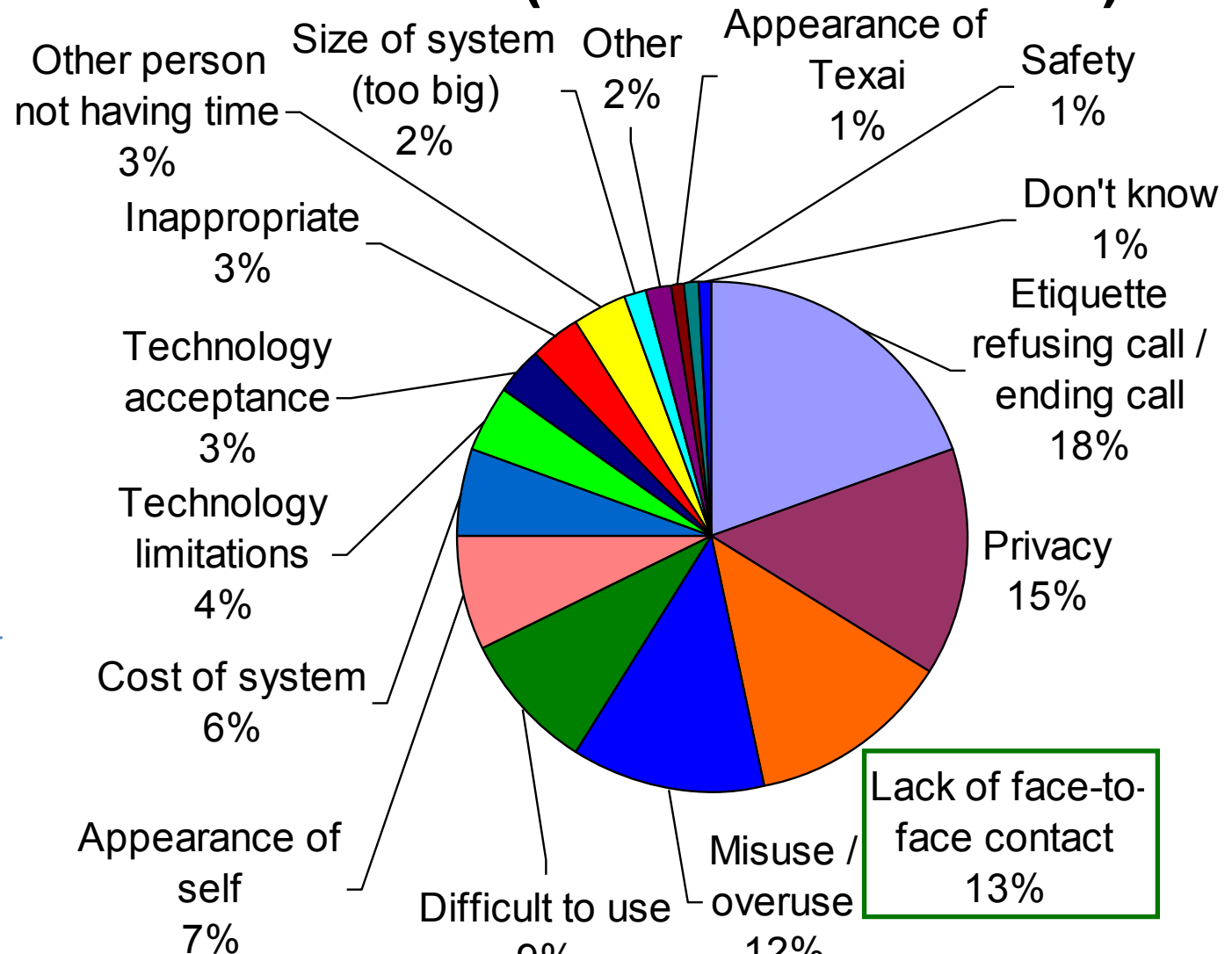
*“What can you do if somebody's walking by and you're talking? Can they just come in and listen? ... if I were in a healthcare situation I wouldn't want the whole world to know what I'm saying to my friend about my condition.”*



12 older adults ( $M = 73.38$ ,  $SD = 7.38$ ), 5 males and 7 females

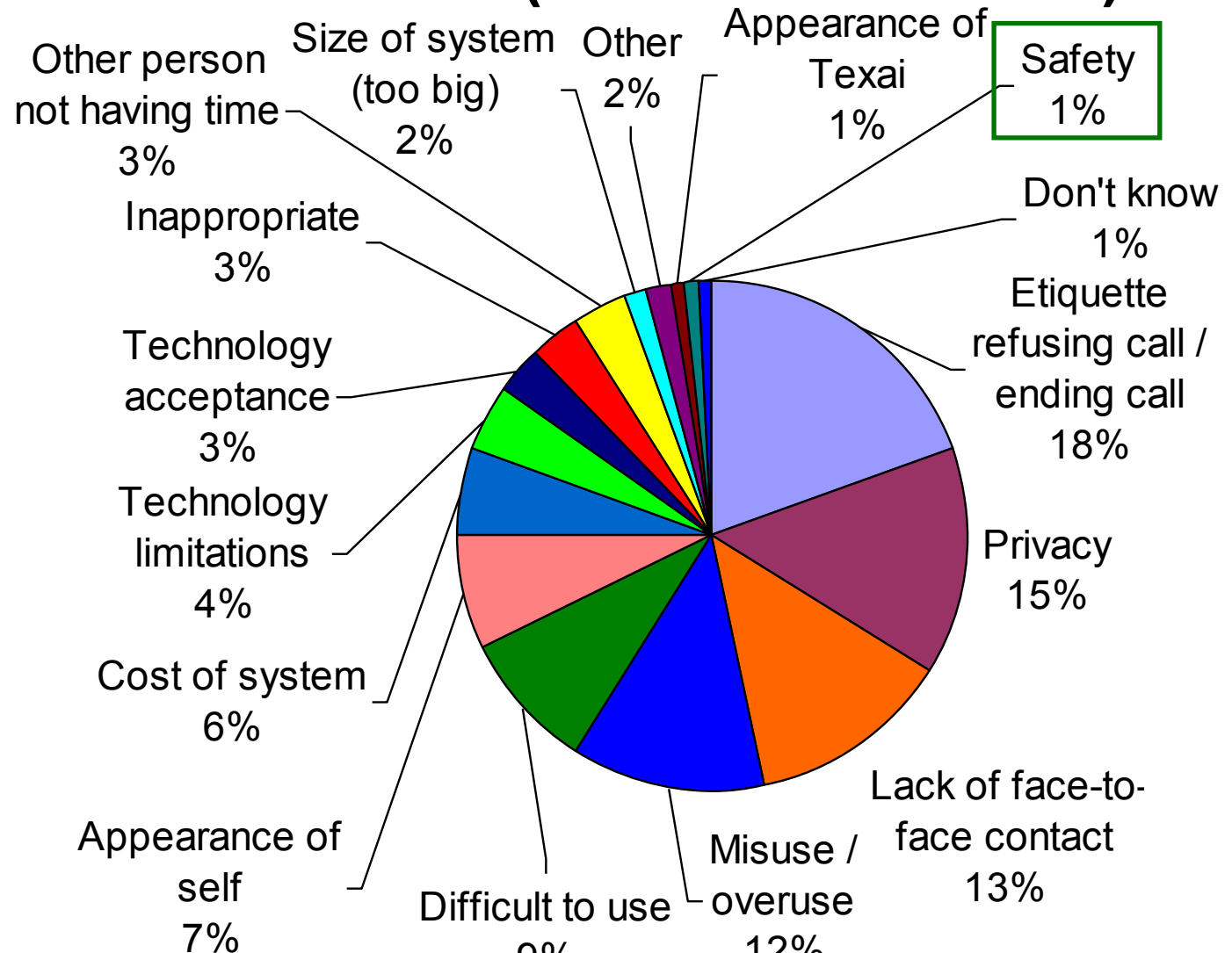
# Overall Concerns (times mentioned)

*“Well, I think **people contact is very important and I wouldn’t want them to use it excessively.** In other words, it’s more important that they see the patient and they have a relationship but use it to help them.”*



12 older adults ( $M = 73.38$ ,  $SD = 7.38$ ), 5 males and 7 females

# Overall Concerns (times mentioned)



12 older adults ( $M = 73.38$ ,  $SD = 7.38$ ), 5 males and 7 females

# Applications: Health Care Staff

- Staff at nursing home or assisted living
  - 67% of older adults mixed opinion
  - 50% of older adults willing for staff to use

## Benefits Staff Use

Benefit	Older Adults (n=12)
Convenience	58.3%
Monitoring	50.0%

## Concerns Staff Use

Concern	Older Adults (n=12)
Misuse / overuse	66.7%
Less personal / less face-to-face contact	58.3%



# Critical Next Steps

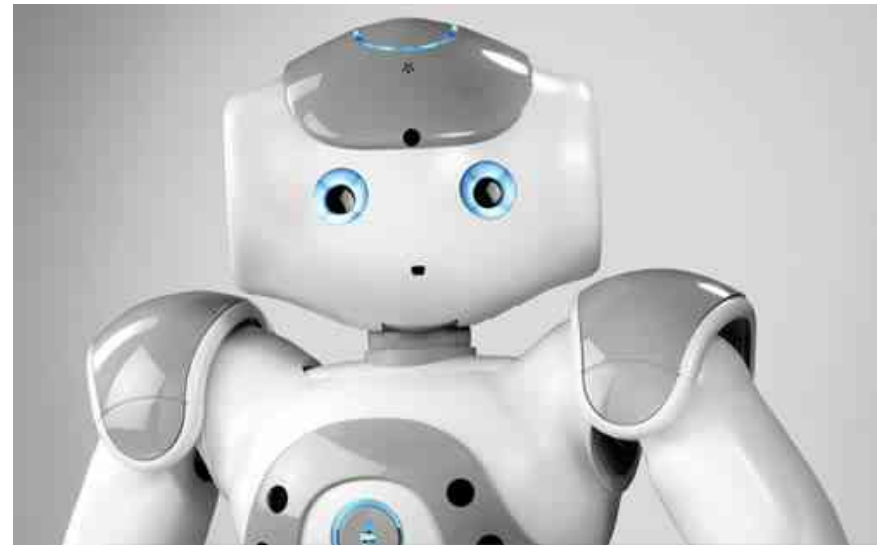
- Communication between:
  - Physical Therapists (exercise)
  - Healthcare providers
- What are opinions of health care staff?
- Usability of robot
- Leisure (museums)



**THE FOUR CHALLENGES IN HRI**  
**CHALLENGE FOUR: THEORY**

# HRI is a young field

- Needs Theory!!!
- “Reinvent the wheel”
- Multidisciplinary
- Subject Matter Experts
- How do current theories/models/frameworks fit?
  - Relatively unknown



# Acknowledgements

- SeniorSMART
- Department of Education
  - National Institute on Disability and Rehabilitation Research
- CREATE
  - [www.create-center.org](http://www.create-center.org)
- NIH/NIA
- NSF
- Willow Garage
  - [www.willowgarage.com](http://www.willowgarage.com)
- Collaborators:
  - Assistive Robotics and Technology Lab
  - Human Factors and Aging Laboratory
  - Healthcare Robotics Laboratory
  - SmartHome

