

School of Psychology

**Human Factors
and Aging
Laboratory**



hfaging.org

*Design and Deployment
of Technology to
Support Healthy Aging*

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Georgia Institute of Technology*

University of Groningen
October 16, 2015

Connection with University of Groningen

prof. dr. ir. K. (Koert) van Ittersum



Organisational unit:

[Faculty of Economics and Business](#)

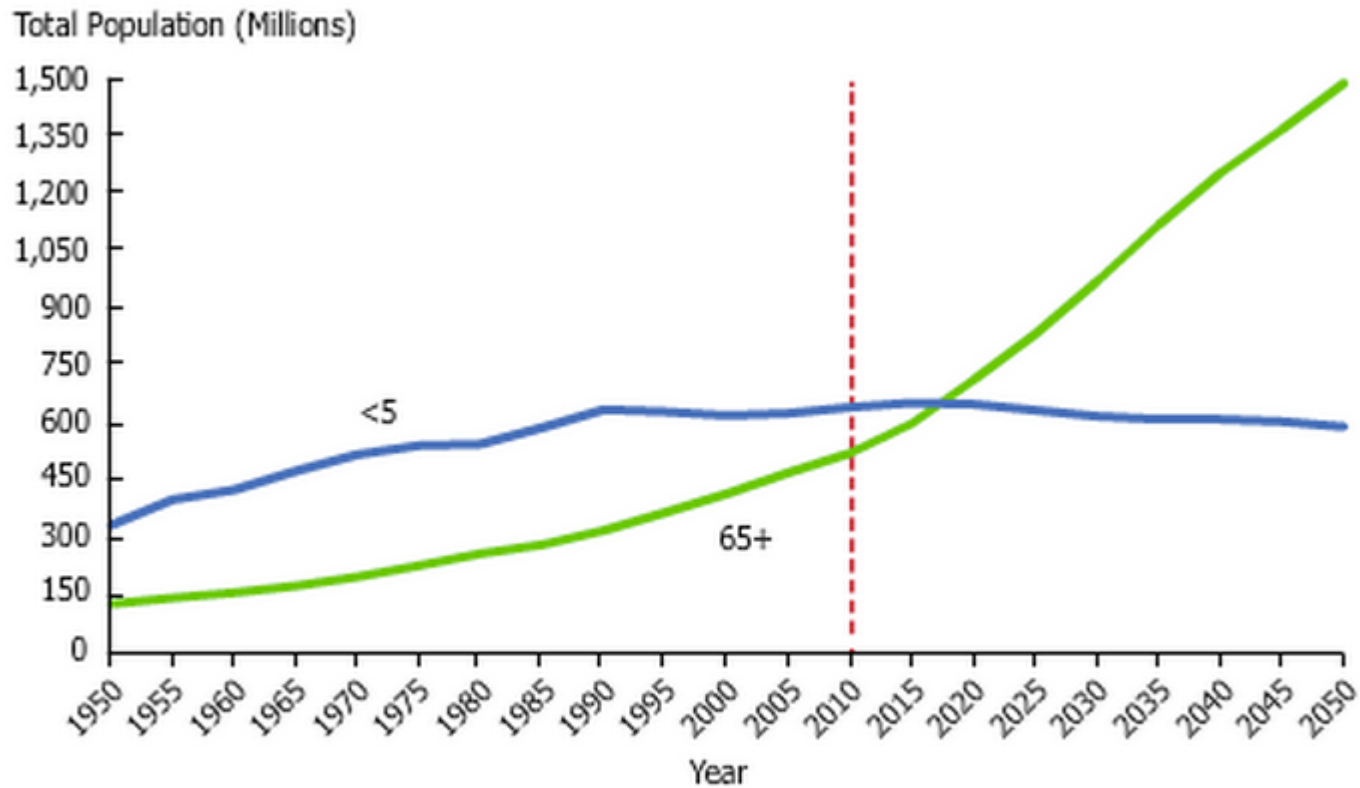
E-mail:

k.van.ittersum@rug.nl

- From ~2005 thru 2010
- Collaborated on research funded by Deere & Company
- Understanding predictors of technology acceptance
- Hoping to start new collaboration related to older consumers

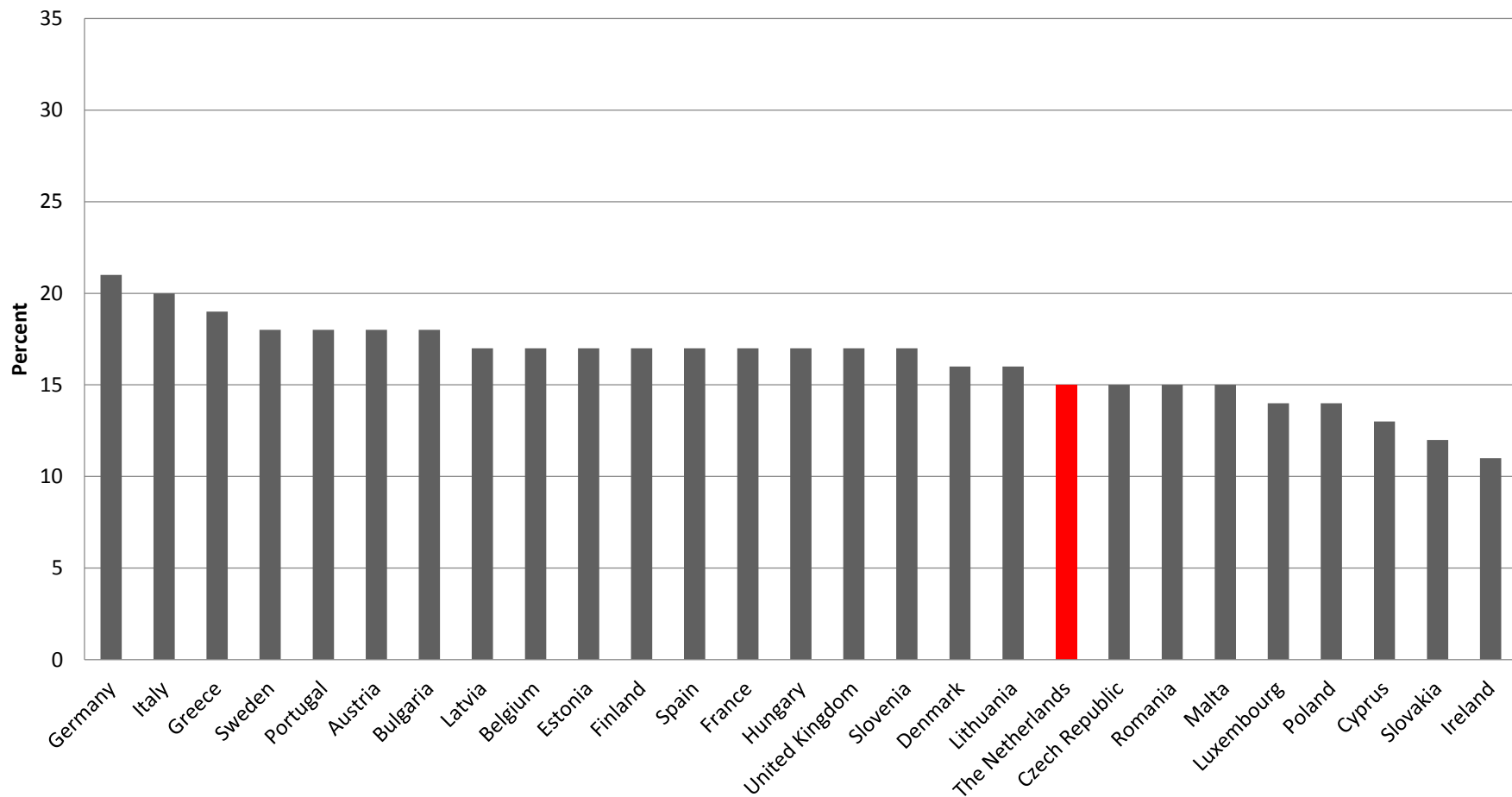
Demographic Trends

World Population



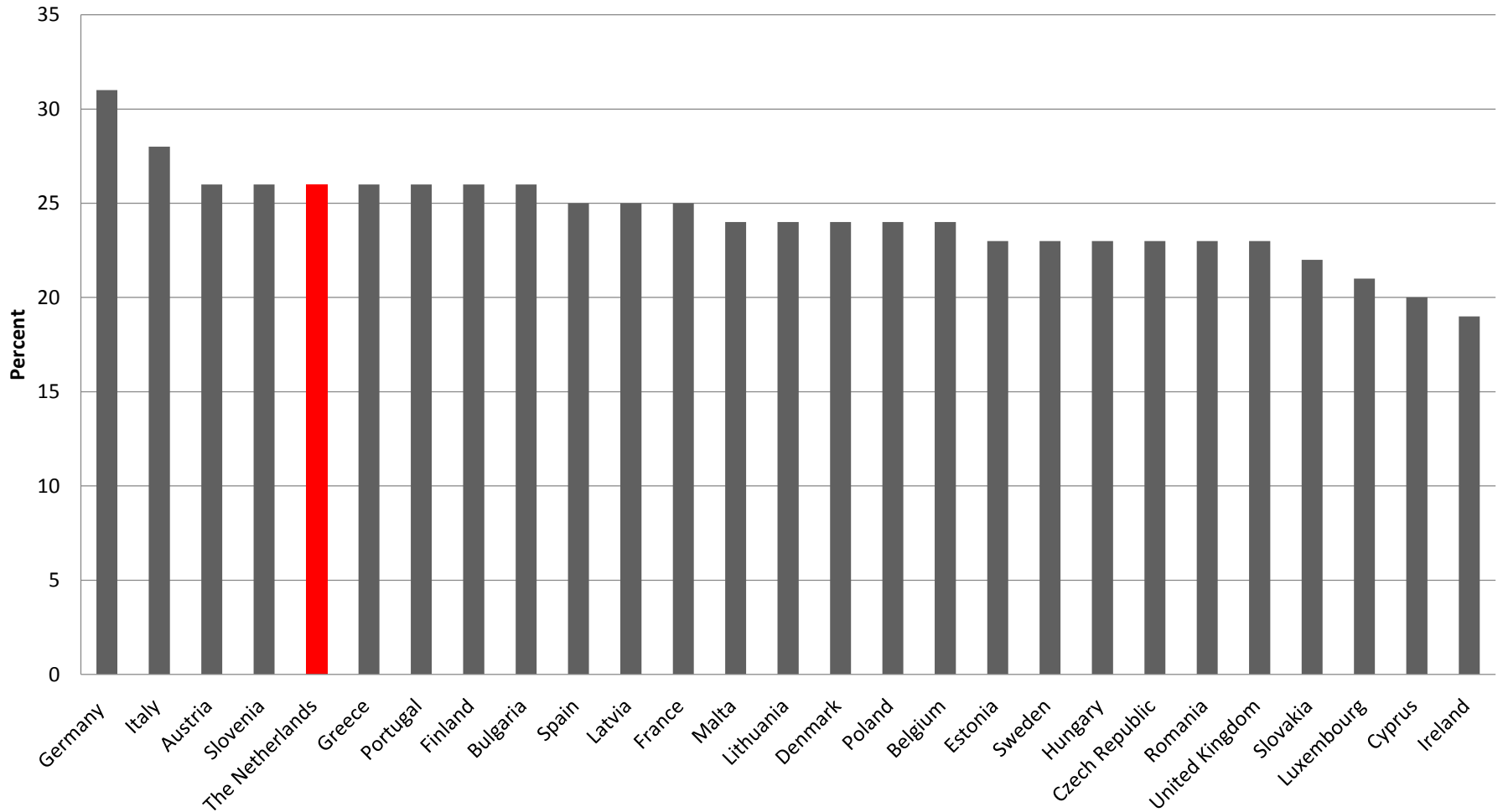
Source: Population Reference Bureau

Percentage of population aged 65 and over in 2010 across the EU



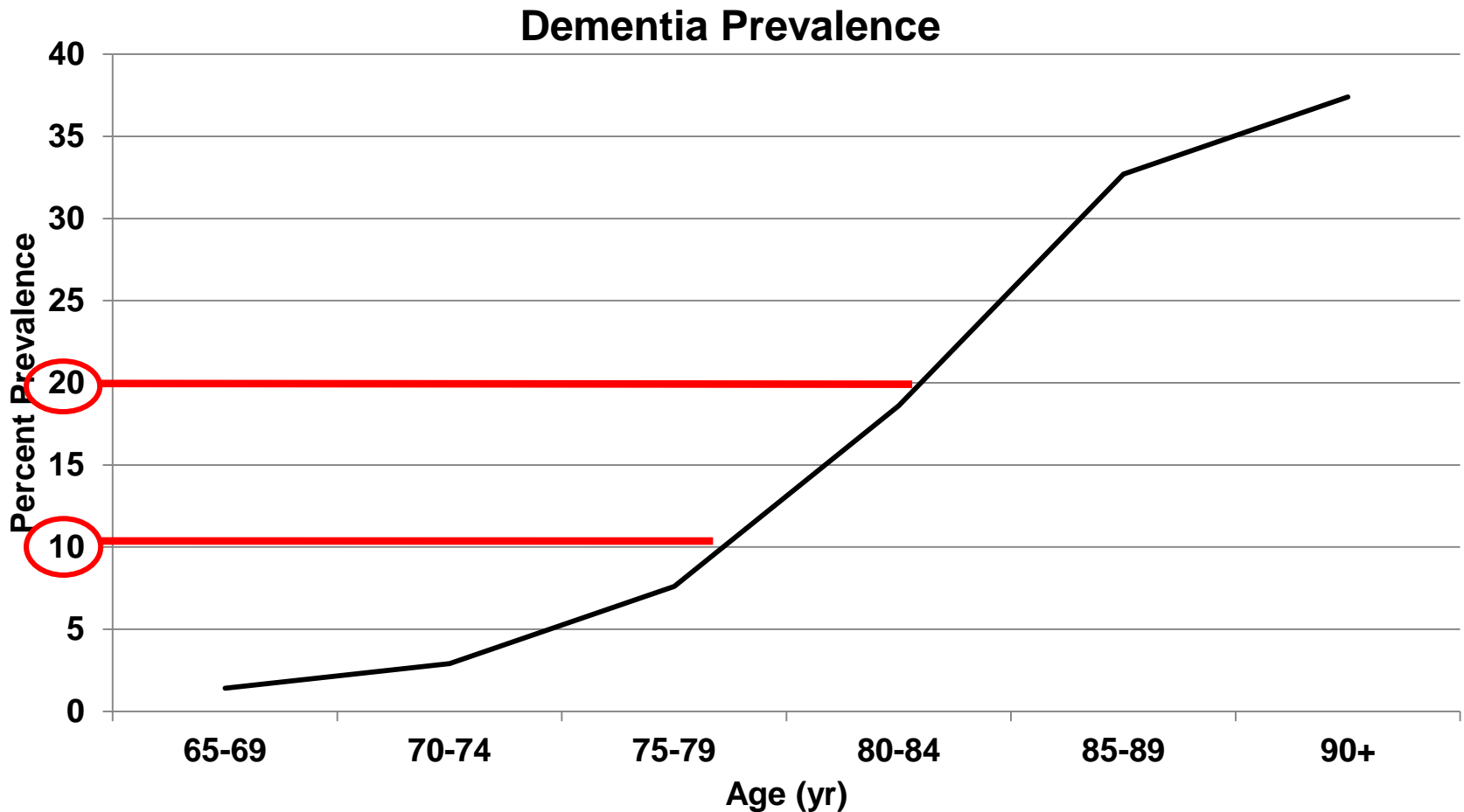
Source: ONS, Eurostat, <http://www.ons.gov.uk/ons/rel/mortality-ageing/focus-on-older-people/index.html>

Percentage of population aged 65 and over in 2035 across the EU



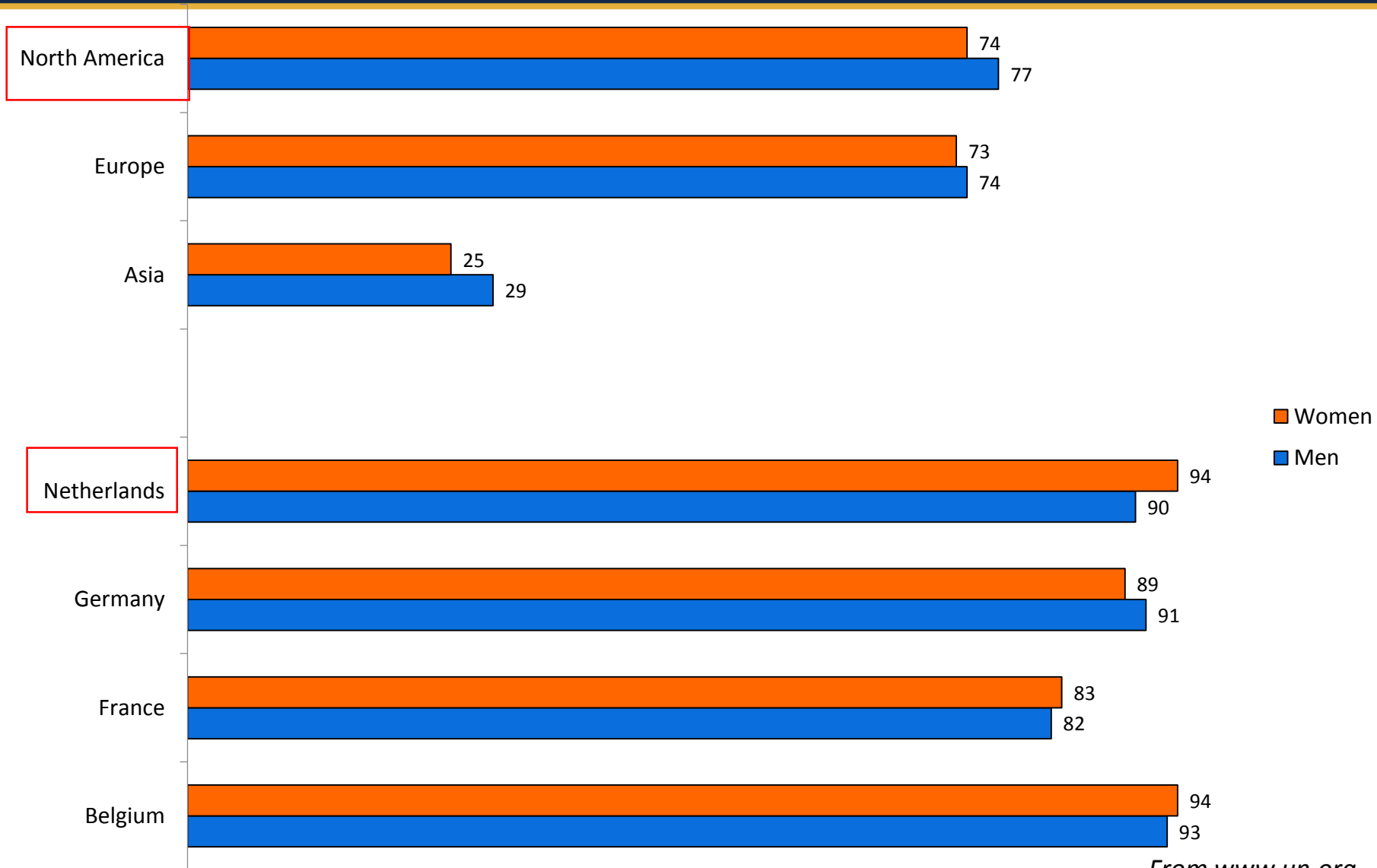
Source: ONS, Eurostat, <http://www.ons.gov.uk/ons/rel/mortality-ageing/focus-on-older-people/index.html>

Dementia & Age



Karel, M. J., Gatz, M., & Smyer, M. A. (2012). Aging and mental health in the decade ahead. What psychologists need to know. *American Psychologist*, 67, 184-198. [Table 1]

Percentage of population aged 60 years or over living independently



Support Healthy (Successful) Aging

- Allow individuals to function effectively and independently as they age.
- Maintain personal autonomy.
- Retain and enhance ability to function in later life.
- Manage chronic conditions.
- Support preventive health (wellness).

My Inspirations





Human Factors and Aging Laboratory

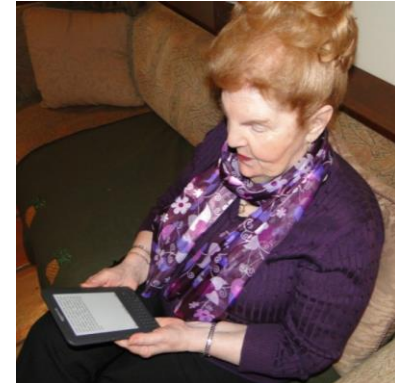
Human Factors is:

- the study of characteristics of people and interactions with products, environments, and equipment
- considering needs and capabilities of users in the design of systems, devices, training, instructions, and environments.
- “Designing for human use.”



The Human Factors and Aging Laboratory Goals:

- Determine abilities, limitations, needs, preferences of older adults
- Contribute to the successful design of technology for older adults
 - usable and useful products and systems
 - effective training & instruction
 - optimized deployment and introduction

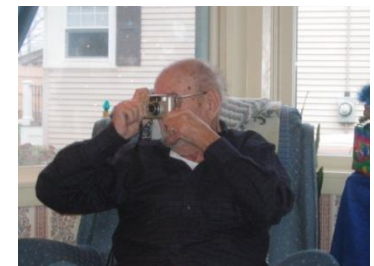
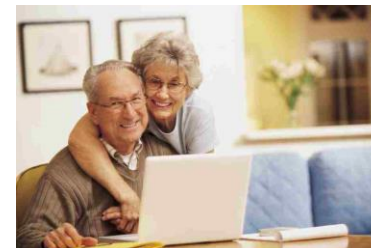


Know thy User

- Who is **THE** older adult?
 - No such thing
 - Older adults vary widely in:
 - Experiences
 - Attitudes
 - Abilities
 - Goals
 - Limitations
 - Needs
 - Think in terms of sub-groups and categories of need

Needs Assessment

- Activities of Daily Living (ADLs)
 - Bathing, eating, drinking, mobility
- Instrumental Activities of Daily Living (IADLs)
 - Preparing meals, paying bills, managing medications, maintaining the home
- Enhanced Activities of Daily Living (EADLs)
 - Social communication, hobbies, new learning, work, volunteering, community participation

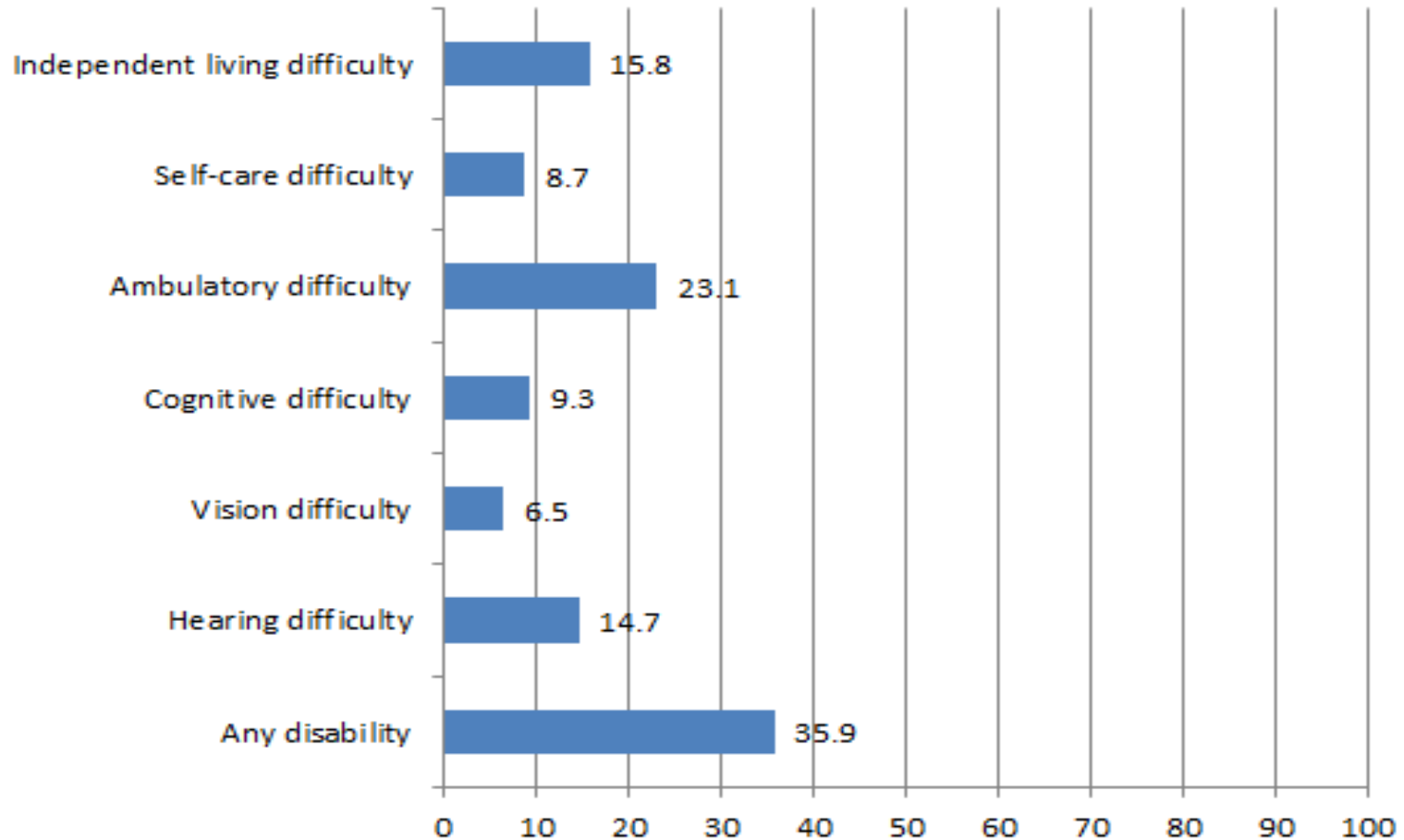


What changes as people age?

- health
- mobility
- vision, hearing
- cognitive functions
- social interaction
- support needs



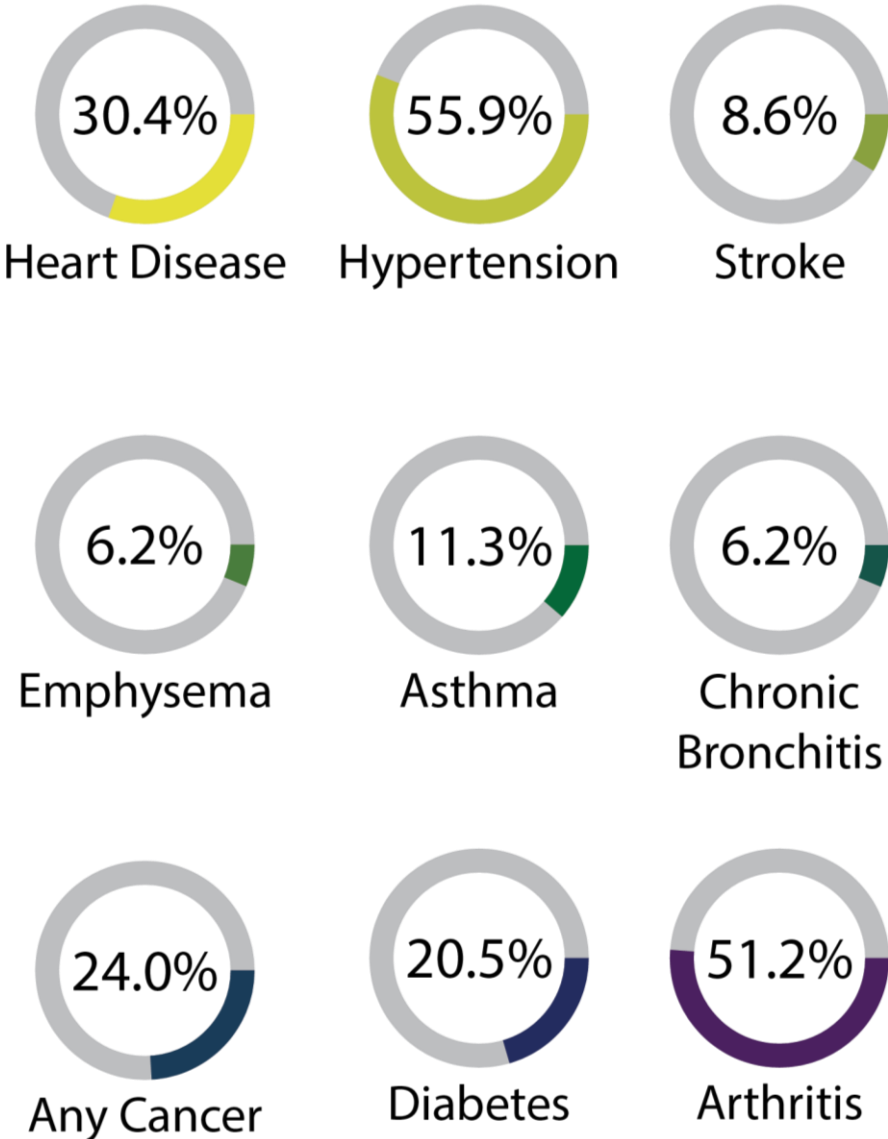
Figure 9: Percentage of Persons Age 65+ with a Disability, 2012



Source: U.S. Census Bureau, American Community Survey: A Profile of Older Americans 2013, pg. 14.

For adults over age 80, the chance of having a disability is 75%.

Percentage of People Age 65 and Over Who Reported Having Selected Chronic Health Conditions, 2009-2010 (many individuals have multiple chronic conditions)



From: *Older Americans 2012* by Federal Interagency Forum on Aging Related Statistics (Indicator 16)

Complexity of Health Self-Management

Making Healthy
Decisions

Chronic Conditions
General Wellness

Opportunity for Technology Supports

- **Potential** and Challenges
 - Wellness management technologies
 - Apps
 - Exergames
 - Robotics
- Sampling of our research in these areas
- Theme:
 - Need to design for older adults' capabilities, limitations, and preferences

Wellness Management: Potential

71% of older adults track weight, diet, or exercise*

44% keep track in their head

41% use paper

12% use a medical device

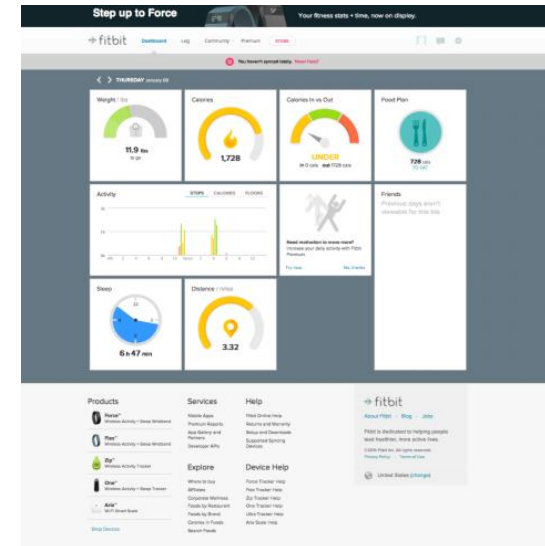
2% use a computer program

1% use an app or mobile tool

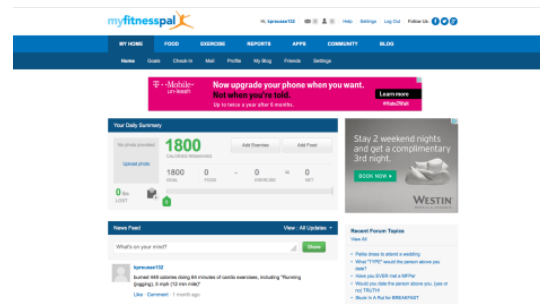
Less than 1% use a website or other online tool

Wellness management technologies can support these activities:

- to set and monitor health-related goals
- manage diseases
- maintain health



Fitbit One



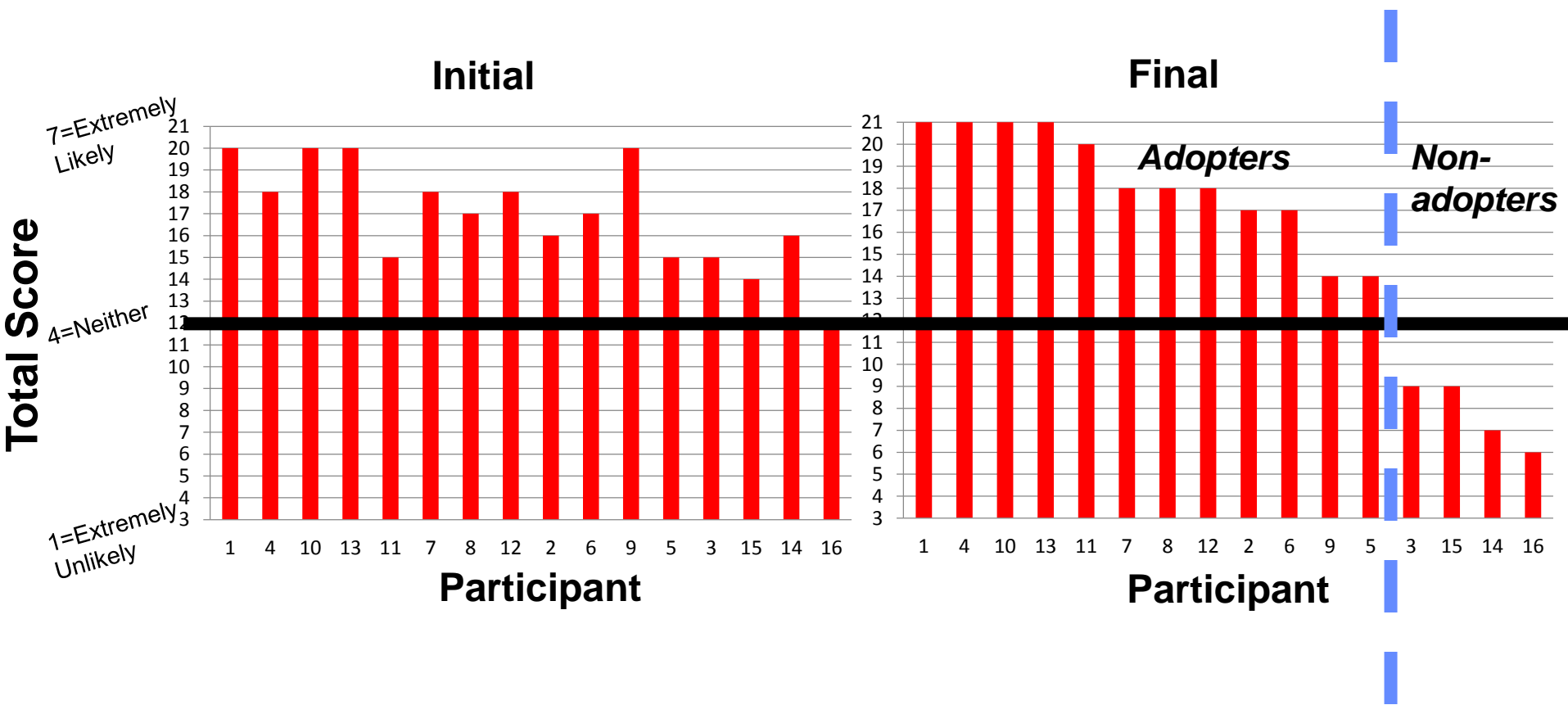
Myfitnesspal.com

*Fox & Duggan, (2013)

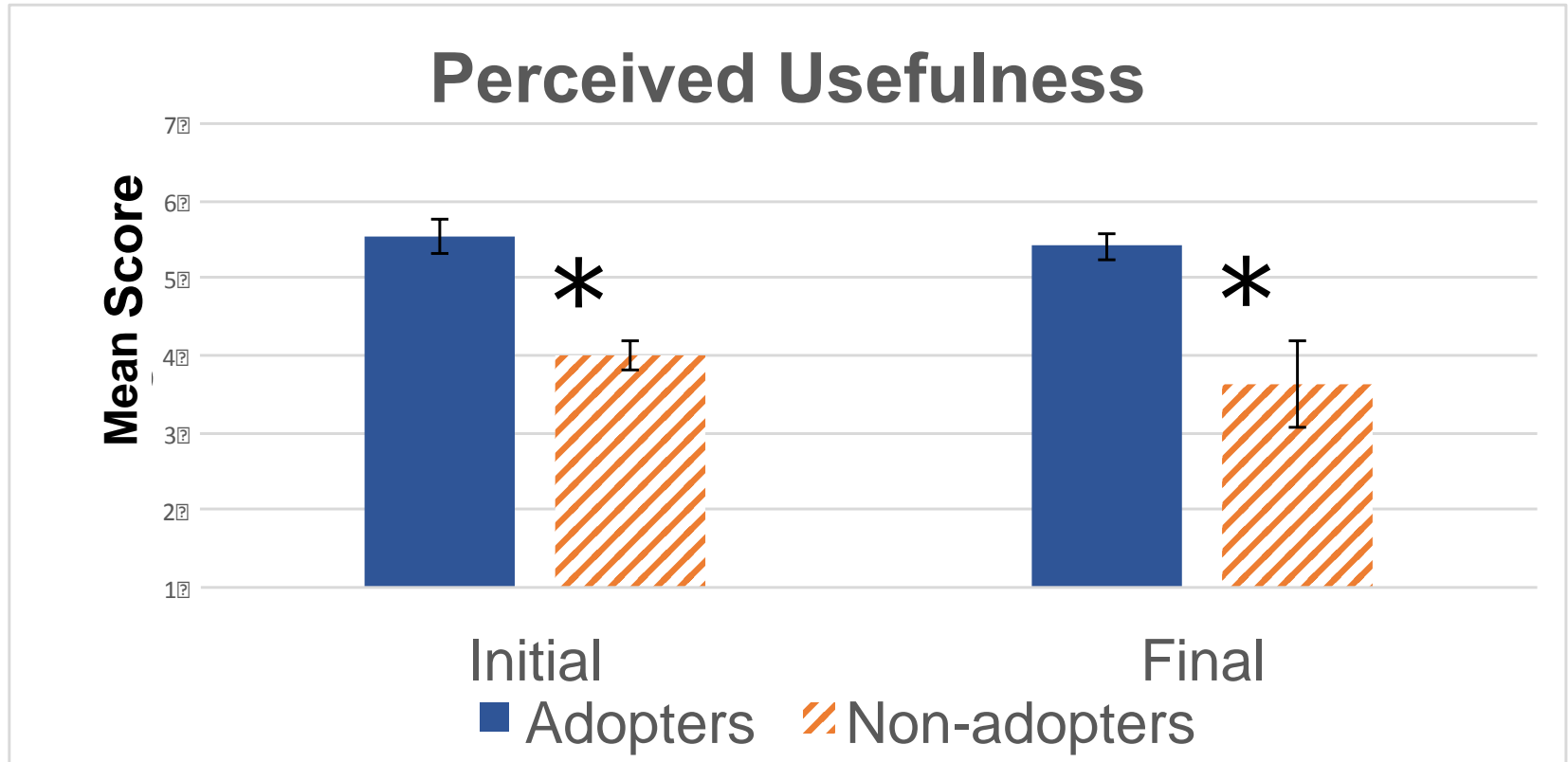
Acceptance Over Time

- Predictors of wellness management technology use for older adults
 - Change over time
 - Assessed older adults usage over 28 days for two devices
 - Diaries and surveys pre and post
- Participants
 - 16 (8 males, 8 females)
 - Ages 65-75 ($M=70.06$, $SD=3.09$)
- Assigned either:
 - Fitbit One
 - myfitnesspal.com
 - (usage and attitude data were similar)

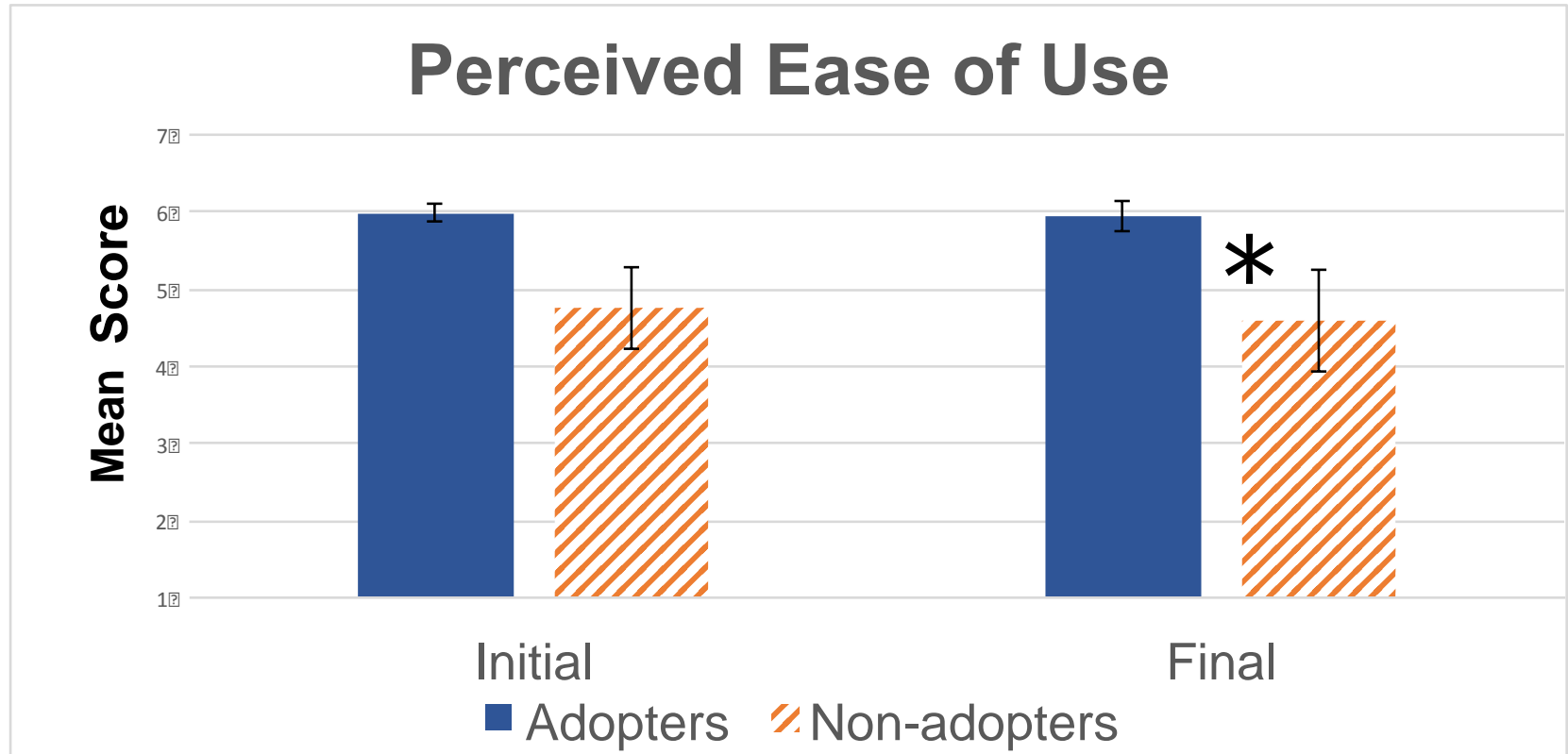
Intent to Adopt



Perceived Usefulness



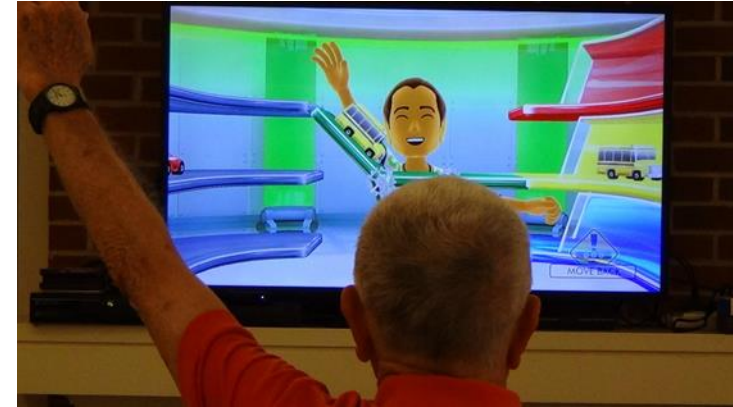
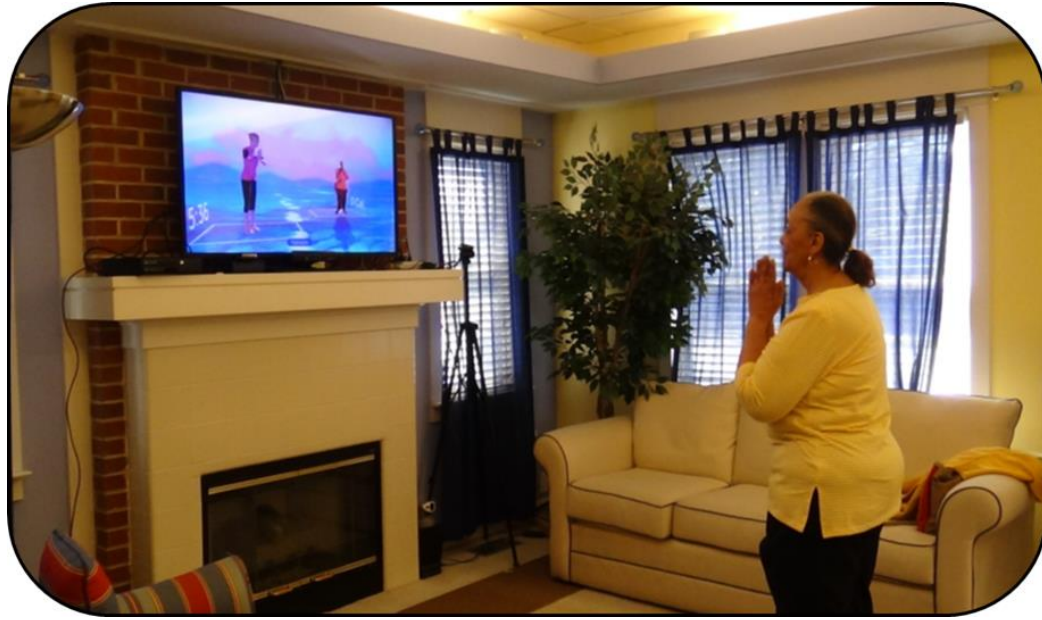
Perceived Ease of Use



Wellness Management: Challenges

- Usefulness
 - Mixture of attitudes
 - potential benefits for promoting exercise and diet habits
 - not better than paper and pencil
- Usability challenges related to:
 - system status visibility
 - error prevention
 - consistency and standards
- Older adults willing to use wellness management technologies, but better design and training required.

Exergames: Potential



Screen Camera: Behind participant



Participant Camera: In front

Video games to promote physical activity...may provide physical, cognitive, and emotional benefits

Evaluated two exergame programs for Microsoft Xbox 360 with Kinect

Perceptions generally positive

“good for physical activity”

valuable as a way to “keep active”

Exergames: Challenges

- Current exergames are not developed with consideration of older adult users' physical and cognitive abilities
 - Difficulties:
 - learning to use gestural controls
 - navigating menus and instructional screens
 - on-screen instructions insufficient
 - not sure when to perform actions
 - perceptual, motor, and cognitive errors
- Need to design games for older adults
- Provide better instruction and training
 - Quick-start guide
 - Evidence-based

Apps: Potential

Managing Chronic Pain

Small Business Innovative Research Grant with
Aptima, Inc. (Camilla Knott)

Collaborators: Pat Parmelee, Terry Fairbanks

Osteoarthritis

- Management is complex
- Many resources for osteoarthritis management exist, but...



...overwhelming amount of information

- Difficult to personalize from general disease model
- Current tools are limited

Stages of Research

- Knowledge requirements
- Available support
- Beliefs about pain factors
- Current approaches
- **Prototype system**
- **Heuristic analysis**
- **Refine prototype**
- **Efficacy of system**
- **Large-scale user testing**
- **System dissemination**



McBride,
et al. (2011)



Barg-Walkow, et al.
(2013)



SBIR Grant Phase I



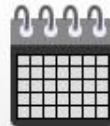
Next Steps



Pain Relief



Enter
Information



View Calendar of
Pain History







View Factors that
affect your pain



Previous day

April 30, 2013 (Today)

Next day

	Morning/ Breakfast	Afternoon/ Lunch	Evening/ Dinner	Overnight/ Bedtime
 Pain	Enter Pain	Enter Pain	Enter Pain	Enter Pain
 Physical Activity	Enter Your <u>Physical Activity</u> Today			
 Mood	Enter Your <u>Mood</u> Today			
 Sleep	Enter Your <u>Sleep</u> from Last Night			
 Weather	62°F average temperature		28.54 in average pressure	
 Medications	Enter Your <u>Medications</u> Today			



Previous day

April 30, 2013 (Today)

Next day

Morning/
Breakfast

Afternoon/
Lunch

Evening/
Dinner

Overnight/
Bedtime

Enter Your Level of Pain This Morning/Breakfast Time

0 1 2 3 4 5 6 7 8 9 10

No pain



Mild



Moderate



Severe



Cancel

Save

Medications

Enter Your Medications Today

Previous month

April 2013

Next month

Press on a day to see more details

Sun Mon Tue Wed Thurs Fri Sat

	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	Today 30				

Average Pain

-  No pain
0
-  Mild
1-3
-  Moderate
4-6
-  Severe
7-10



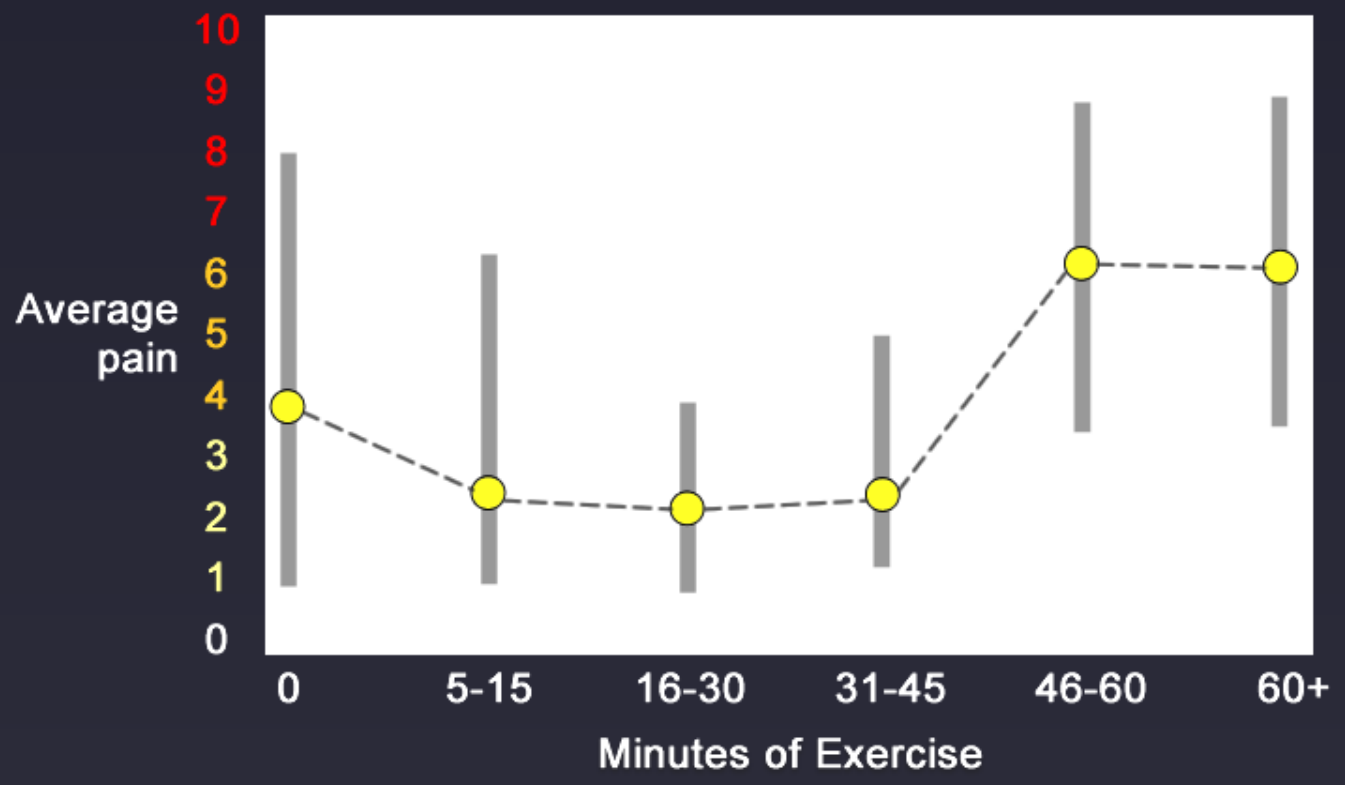
- Choose a factor
- Physical Activity**
 - Sleep
 - Mood
 - Weather
 - Medications

How **physical activity time** and **pain** are related over the last 3 months

How to read this graph

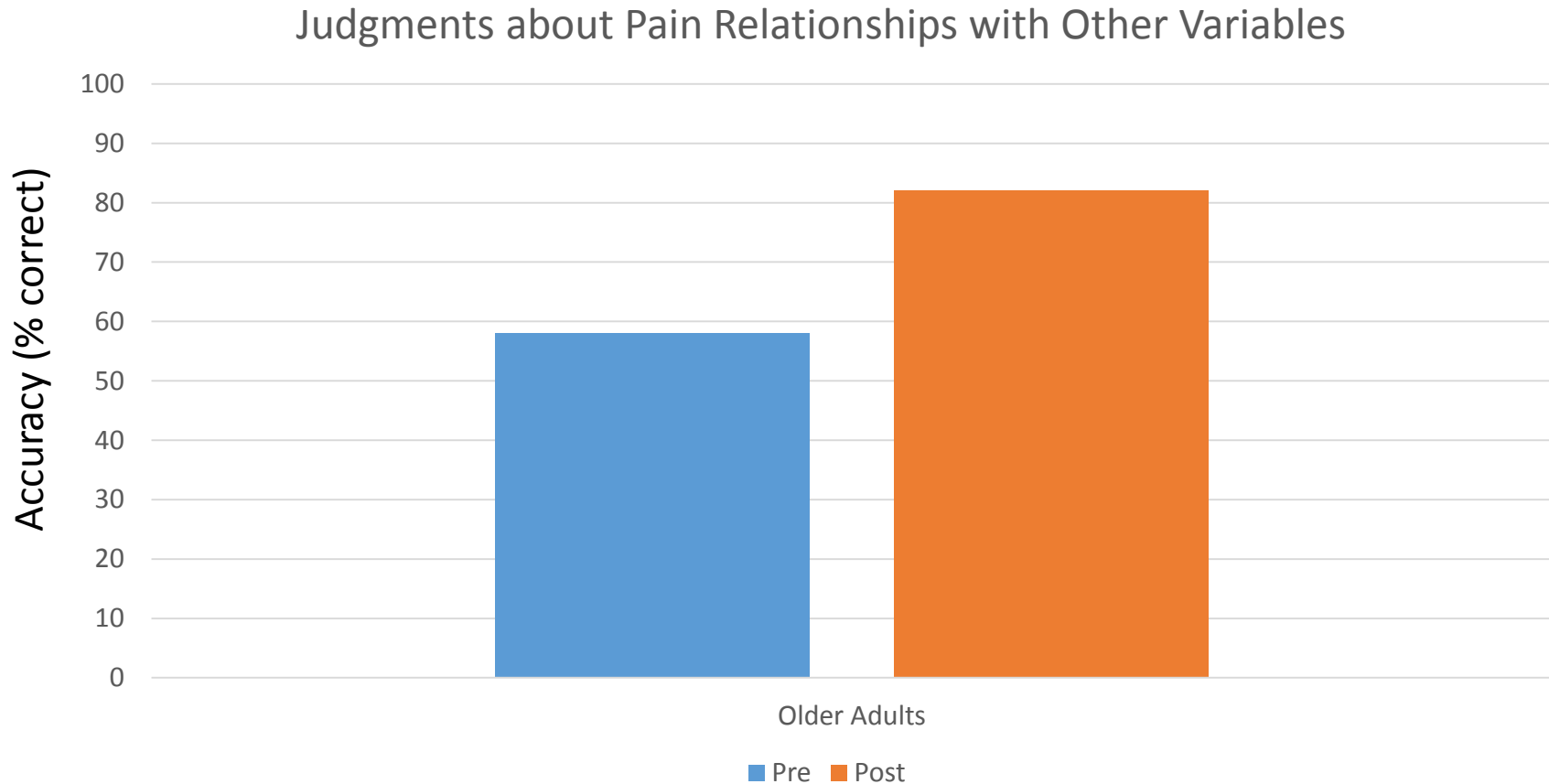
● My average pain on days when I exercised that amount

▬ My pain was within this range when I exercised that amount



Prototype System with Simulated Data

- Improved older adults' understanding of pain triggers



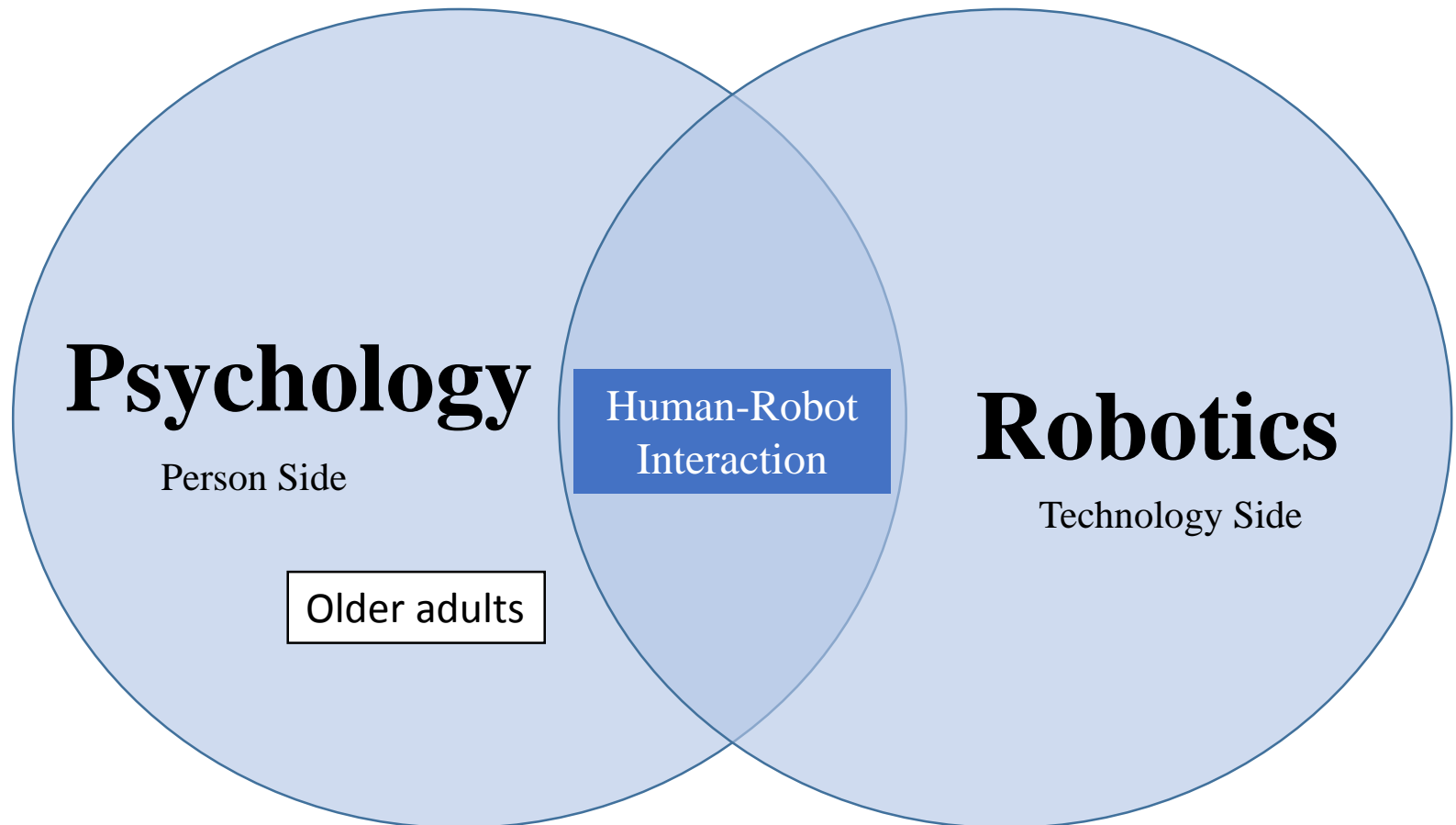
- Next step: large scale trial of whether STAMP reduces pain

Apps: Challenges

- Most available apps not developed with consideration of older adult users' physical and cognitive abilities or needs in mind
- Need to understand
 - Information requirements
 - Test comprehension of information displays
 - Assess efficacy of using the apps for health management (e.g., reducing chronic pain)

Human-Robot Interaction (HRI)

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



How do we design robots to support successful aging?

- What do robots need to do?
 - Communicate with humans
 - Show emotions
 - Perform tasks for the person
 - Be trustworthy
 - Have an appearance people like
 - Provide social support
- Categories of Robots
 - Personal Service Robot
 - Social Robot
 - Telepresence Robot



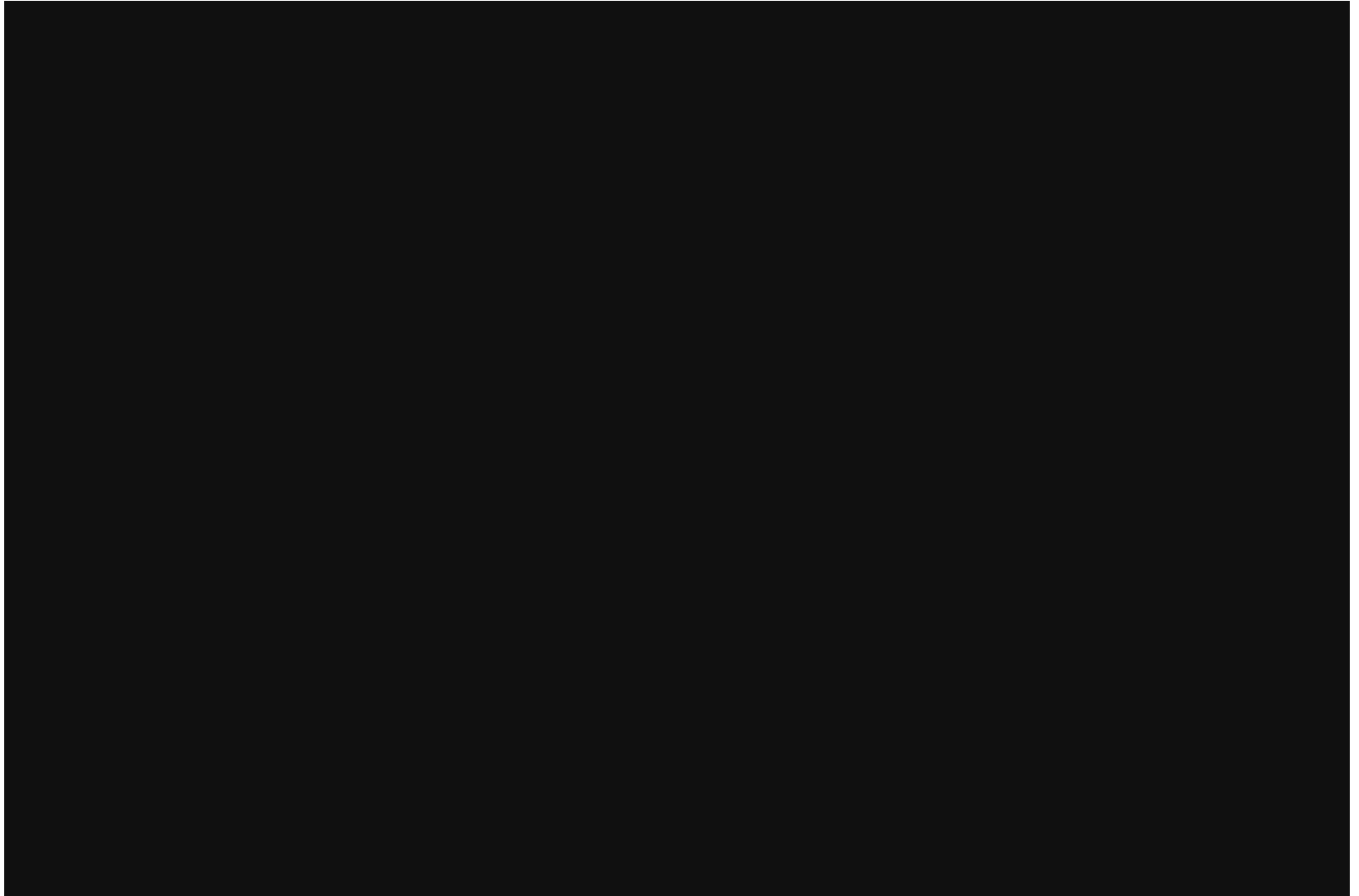
GATSBII

(GATechServiceBotwithInteractiveIntelligence)



Collaboration with Dr. Charlie
Kemp Director of the Healthcare
Robotics Lab

Video of GATSBII's Functionality



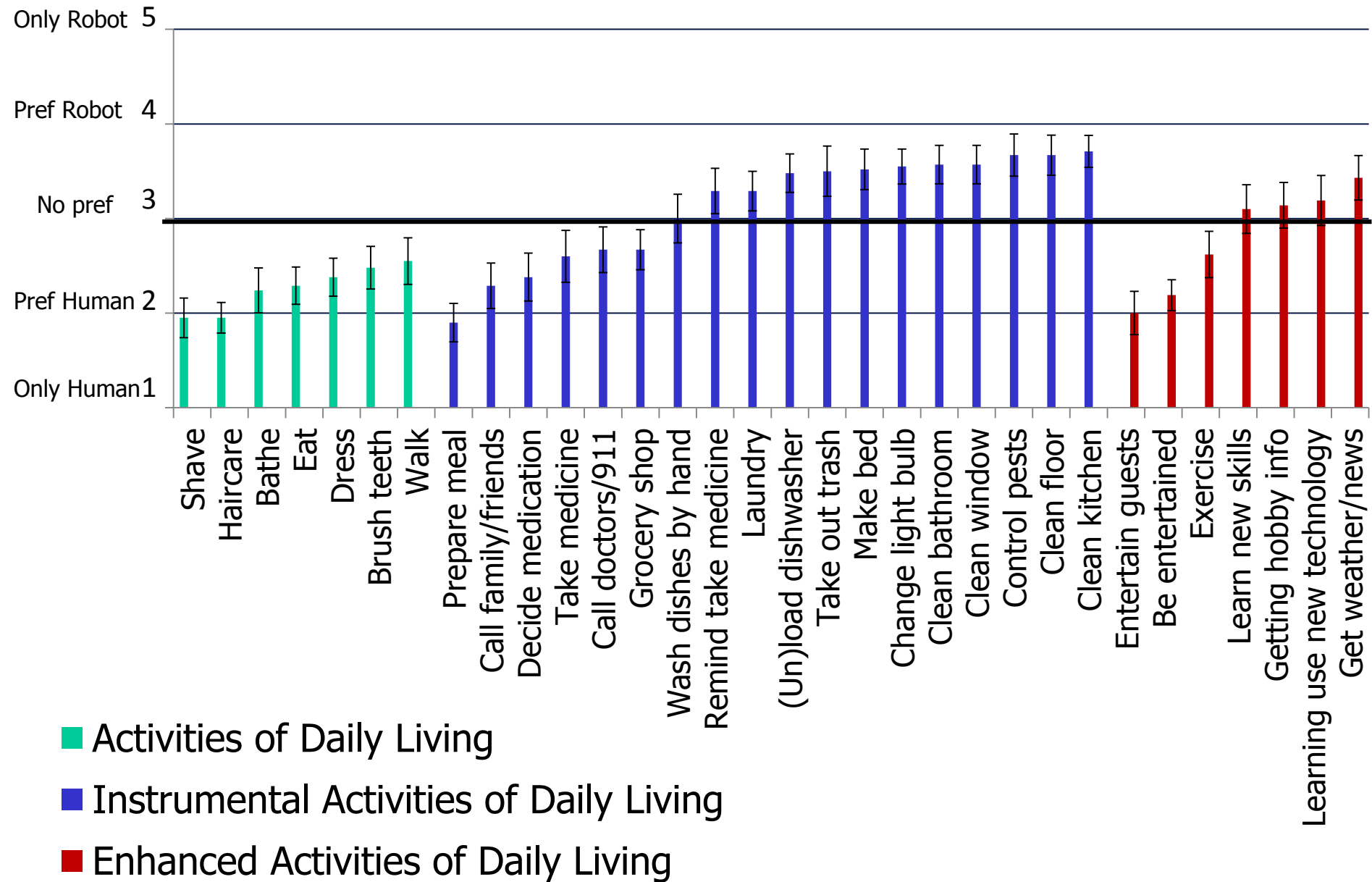
Assistance Preference Questionnaire

Smarr, C.-A., Mitzner, T.L., Beer, J. M., Prakash, A. Chen, T. L., Kemp, C. C., & Rogers, W. A. (2014). Domestic robots for older adults: Attitudes, preferences, and potential. *International Journal of Social Robotics*.

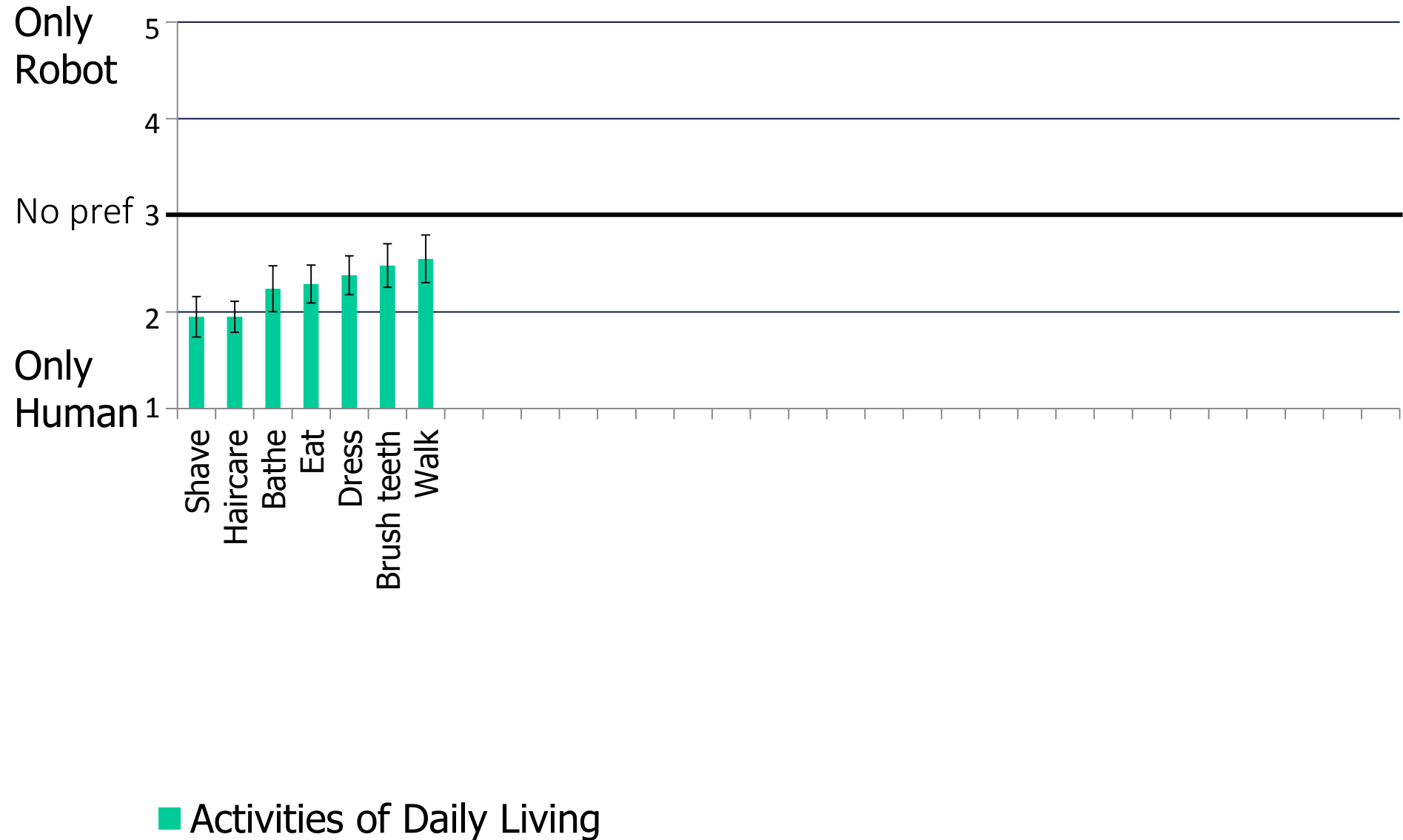
- Imagine you need assistance – would you prefer a human or a robot?
- 48 home-based tasks

If I needed assistance with...	If I needed assistance, I would prefer help from...				
	Only a human ₁	Prefer a human ₂	No Preference	Prefer a robot ₄	Only a robot ₅
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

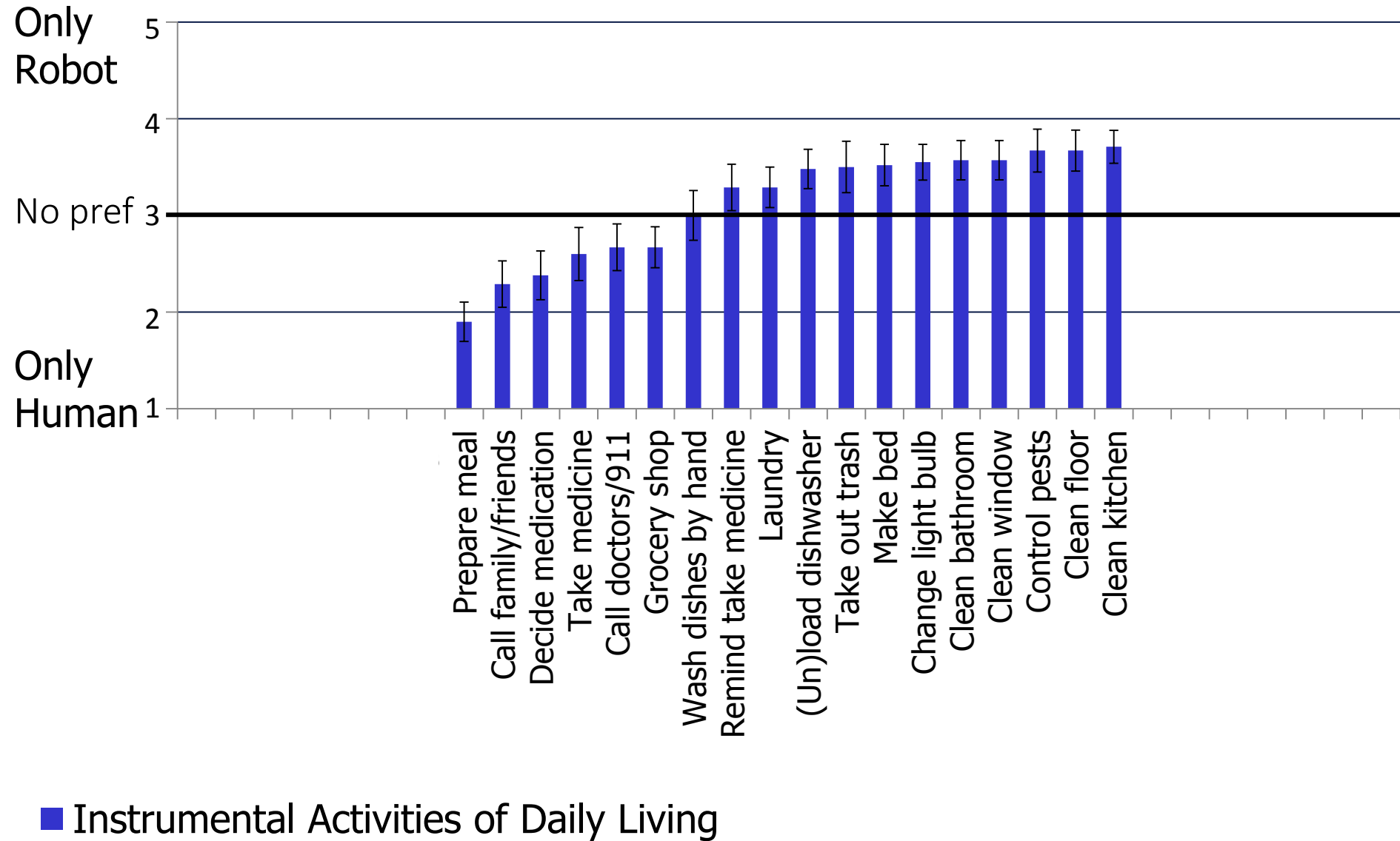
Assistance Preference – Robot vs. Human?



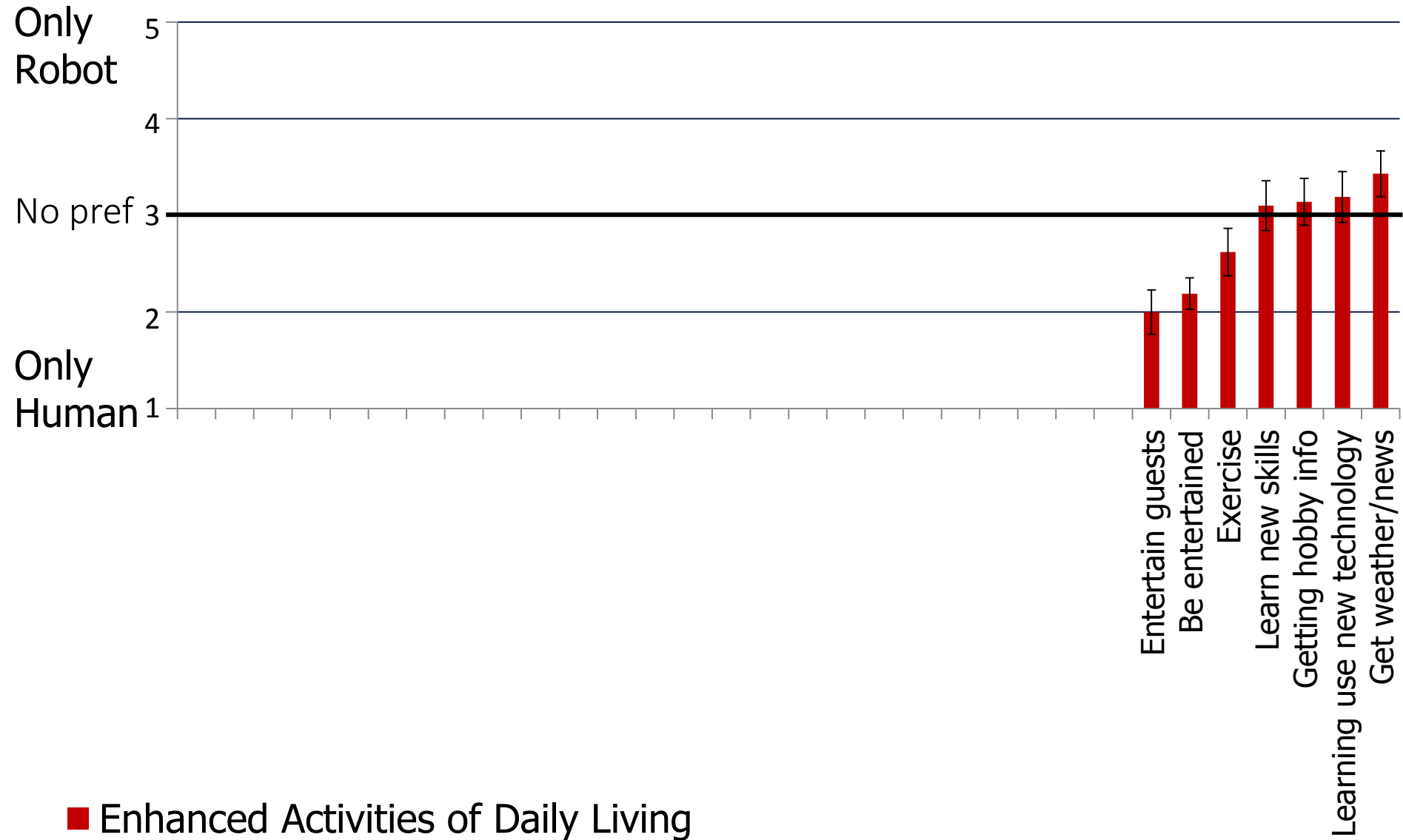
Assistance Preference – Robot vs. Human?



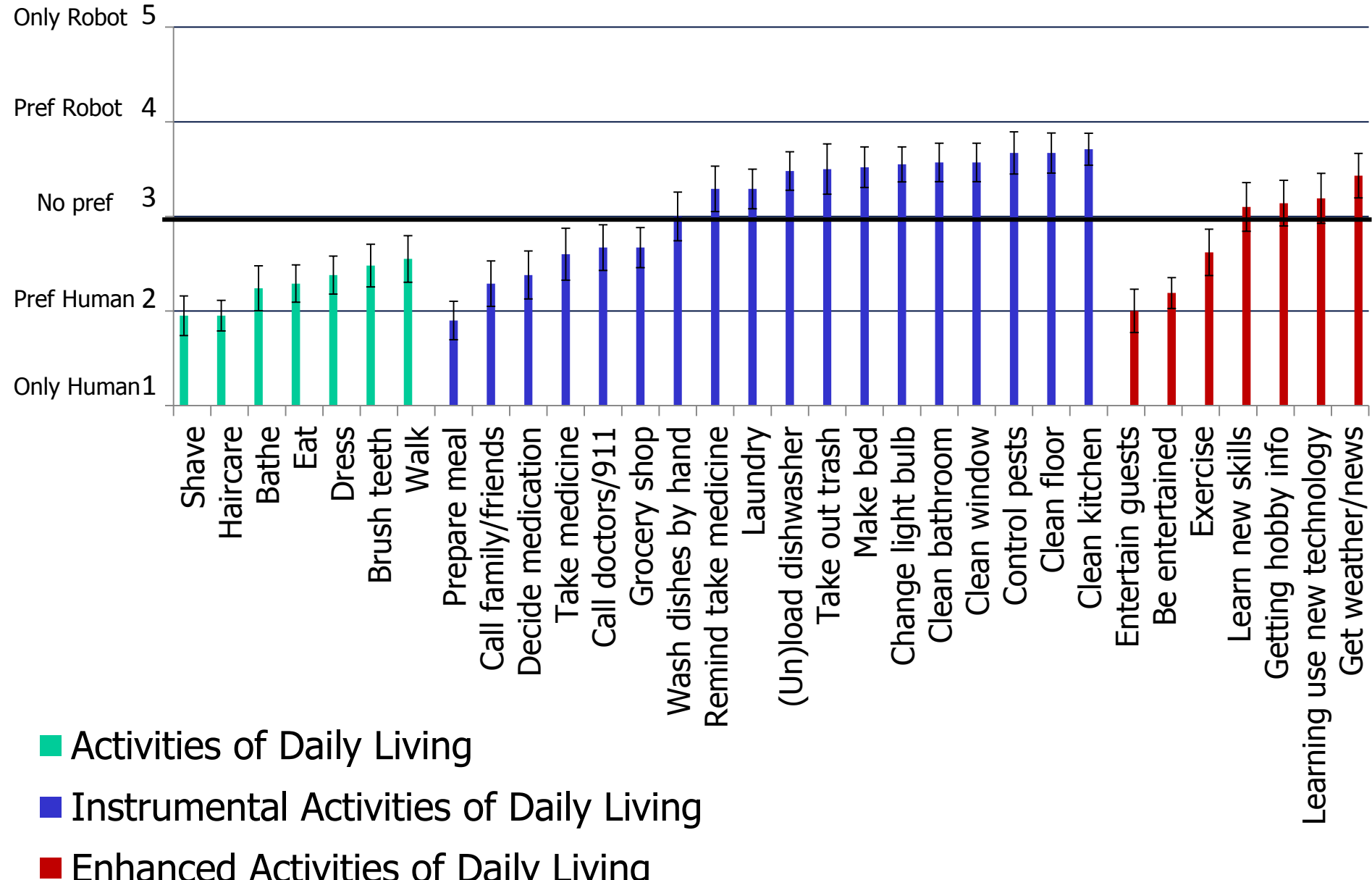
Assistance Preference – Robot vs. Human?



Assistance Preference – Robot vs. Human?



Assistance Preference – Robot vs. Human?

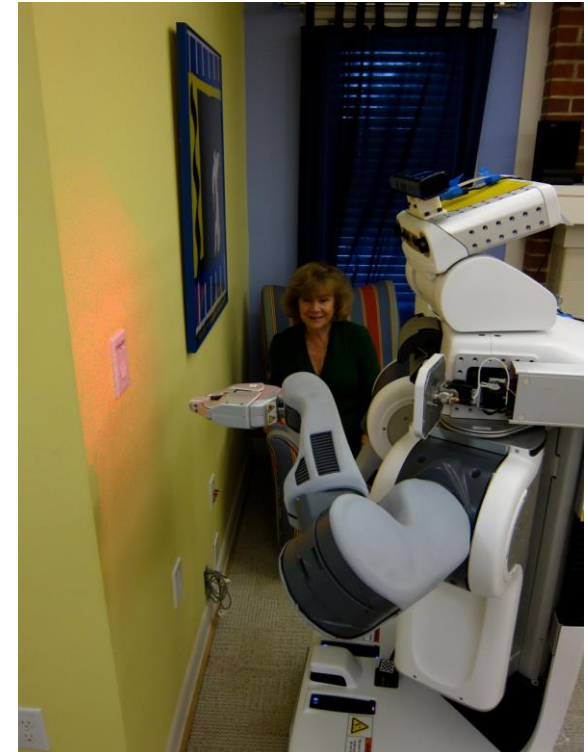




Delivering Medication (video)



Clearing away clutter



Learning Light Switches

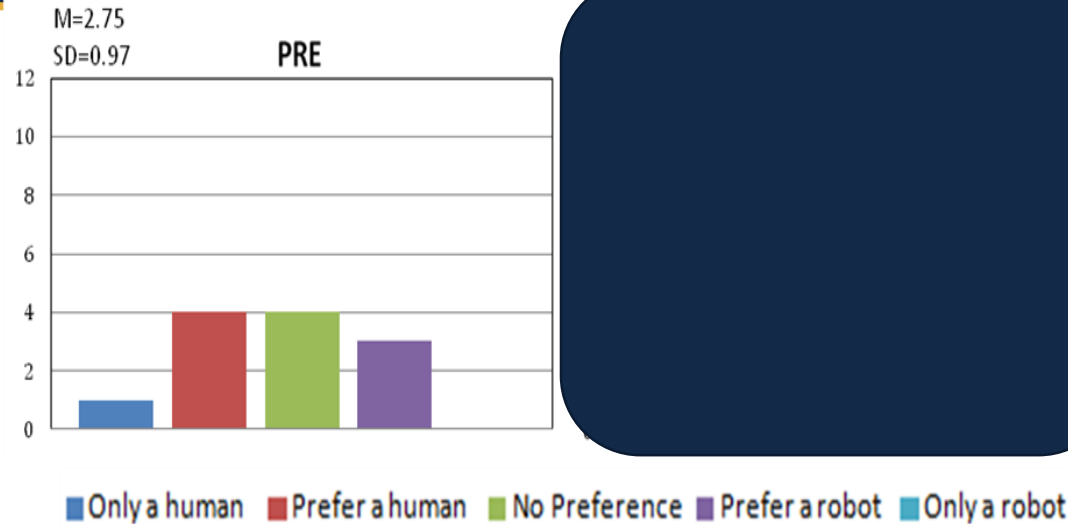
Older adults were:

- Very positive about the robot
- Not at all frightened
- Excited about the potential for the future

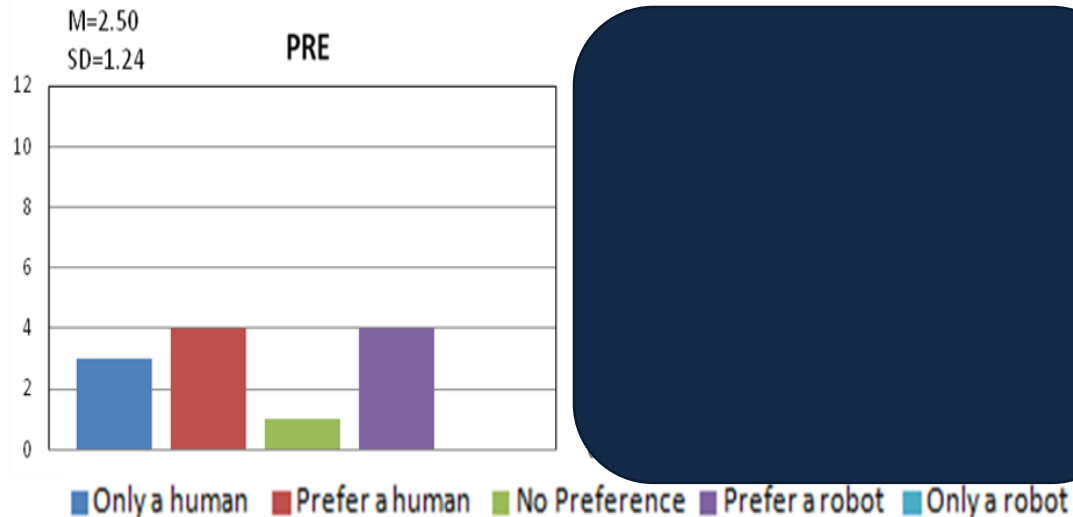


Attitudes more Positive after Interaction Experience

Being Reminded to Take Medication



Delivering Medication to You

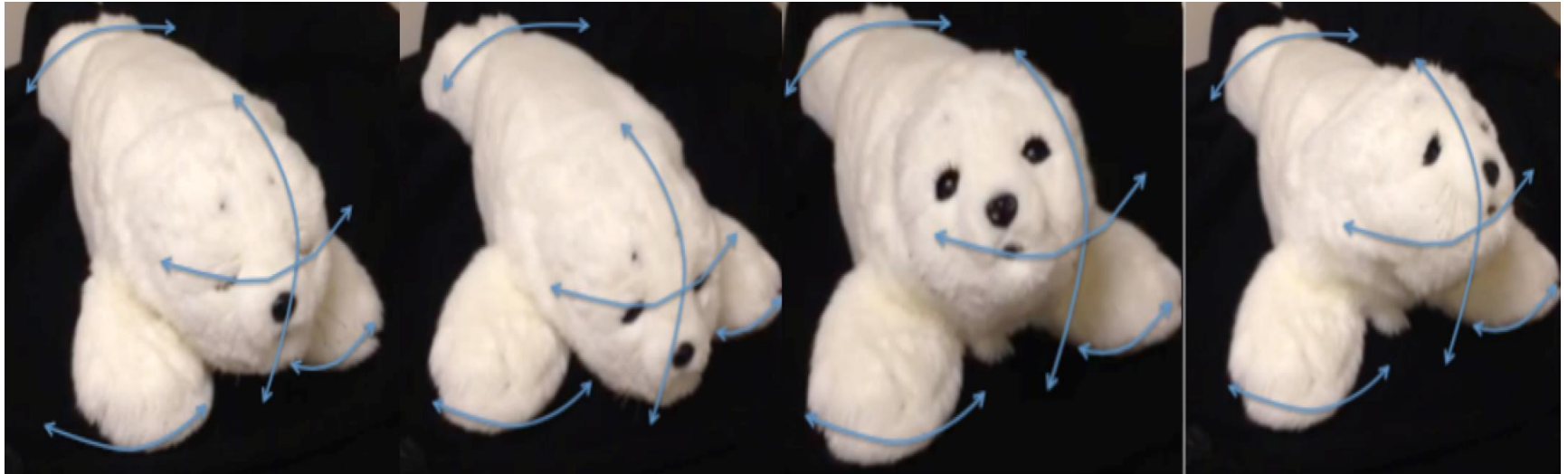


Personal Service Robot: Challenges

- Acceptance by older adults
 - Trust
- Design for home spaces
- Reliability, consistency, transparency
- Maintenance
- Cost

Social Support Robot: PARO

- Designed by Dr. Takanori Shibata – to elicit happiness and relaxation
 - Modeled after a baby harp seal
 - Moves and makes similar sounds



- Tactile sensors: paws, back, head, chin, whiskers
- Ability to sense light, touch, and sound

Social Support Robots: Potential



Study 1:

Do *healthy* older adults' perceive Paro as being useful in their daily lives?

Who might Paro be used by?

How might Paro be used?

Overall, participants had positive attitudes toward Paro

Perceptions of Usefulness

“Right now, no. I wouldn’t. Say another year from now, I might lose some of my functions, my legs or something.”

“I think it would be very comforting, and if I feel angry or distressed I think he would be a very good pick-up, definitely a good pick-me-up.”

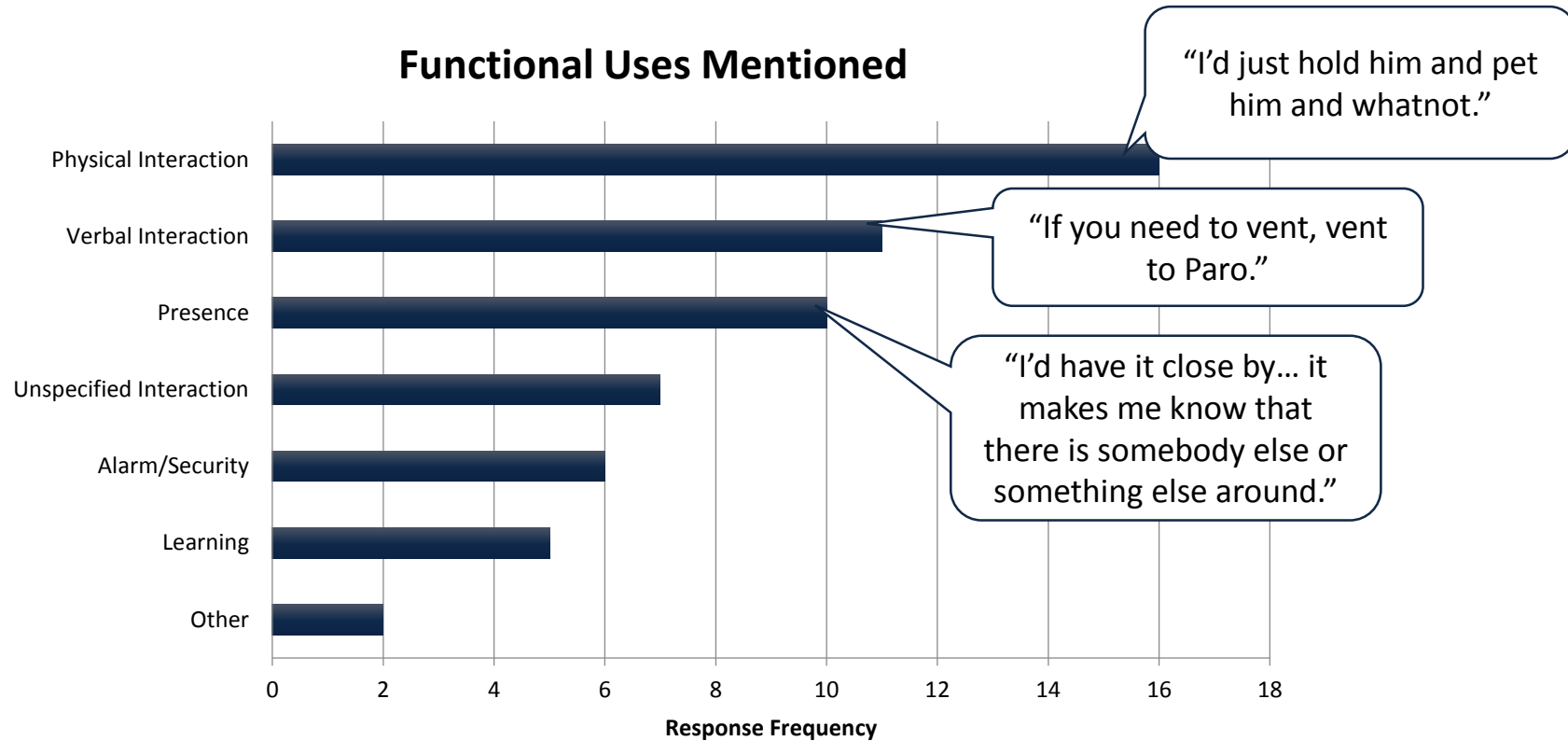
“I suppose if they were desperate for interaction Paro could fill a gap. I don’t have that feeling as it pertains to myself.”

“Yes, I could see especially with older people who are alone... either living on their own or in housing where pets aren’t allowed. “

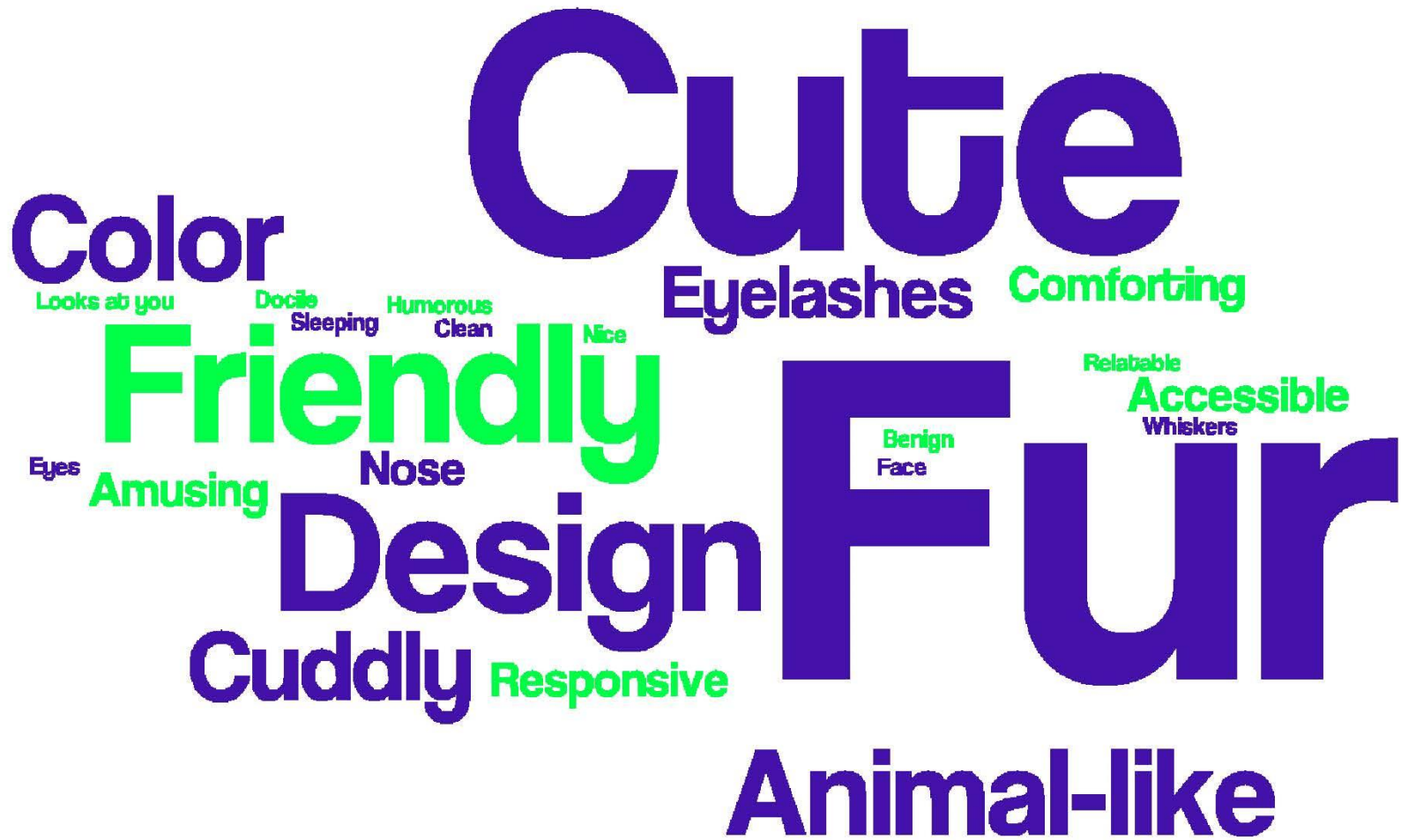
	Useful to you?	Beneficial to people?
Maybe	1	6
No	11	1
Yes	18	23

- Of the 30 participants, most perceived Paro as being useful to themselves and beneficial to people in general

Types of Functional Uses Mentioned



- Of the functional uses, mentions of either physical or verbal interactions were most prevalent



Likes: **Physical** **Personality**



Social Support Robot: Challenges

- Limited research on whether PARO is effective at reducing stress, providing companionship
- Characteristics of social/companion robots
 - Appearance
 - Interaction methods
 - Responsiveness
 - Learning about person
 - What makes them effective

Telepresence Robot: Potential



Facetime



Telepresence: Kubi
www.revolverobotics.com



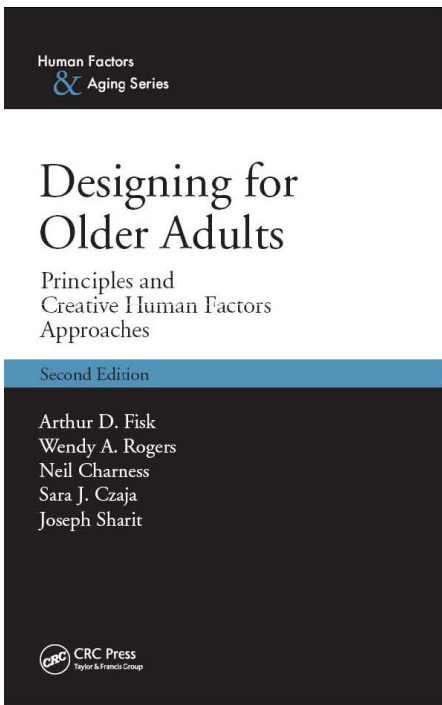
Henry Evans with his BeamPro

Telepresence Robot: Challenges

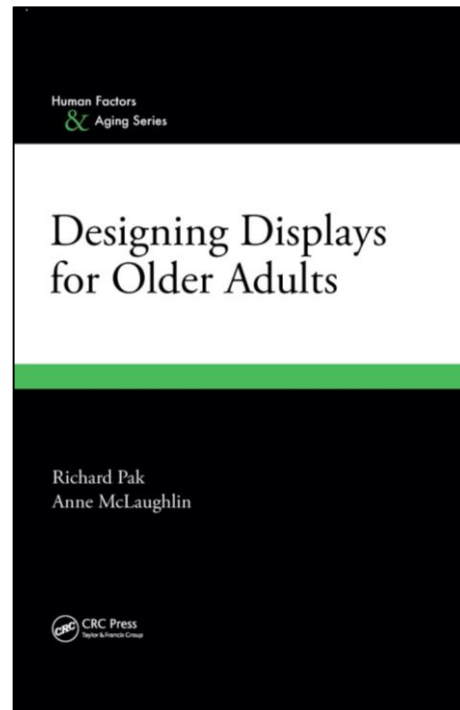
- Ease of Use
 - Usability of interface
 - Control methods
- Usefulness
 - Rehabilitation support
 - Group exercise
 - Social communication

Conclusion

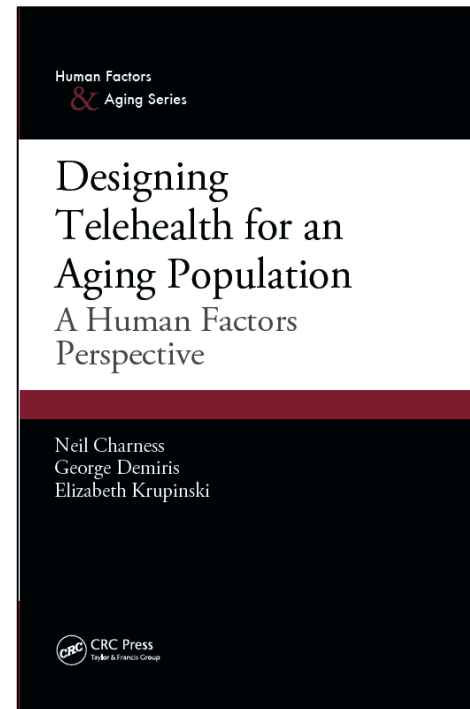
- Current technologies can support health and well-being of older adults
 - Design adaptations
 - Training
 - Proper introduction into everyday lives
- Emerging technologies have tremendous potential but success depends on:
 - understanding older adults' capabilities, limitations, needs, preferences, attitudes, and goals
 - involving older adults in process of development and testing



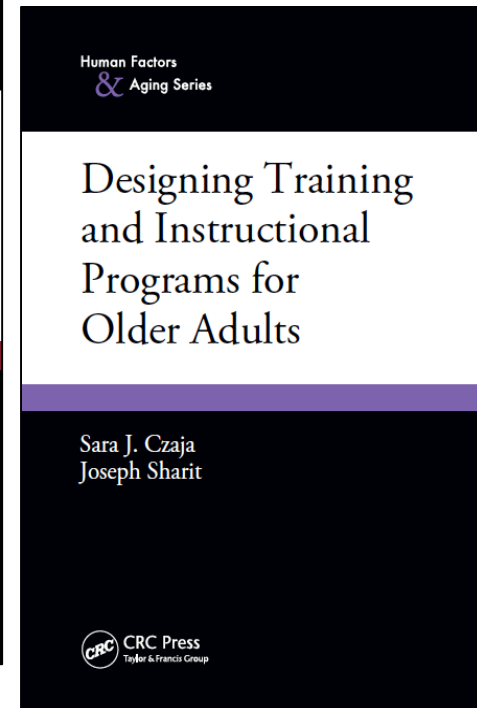
2009



2010



2011



2012

In development:

Transportation Systems; Home Modifications;
Technologies for Assisted Living Communities

Research sponsored in part by U.S. government:



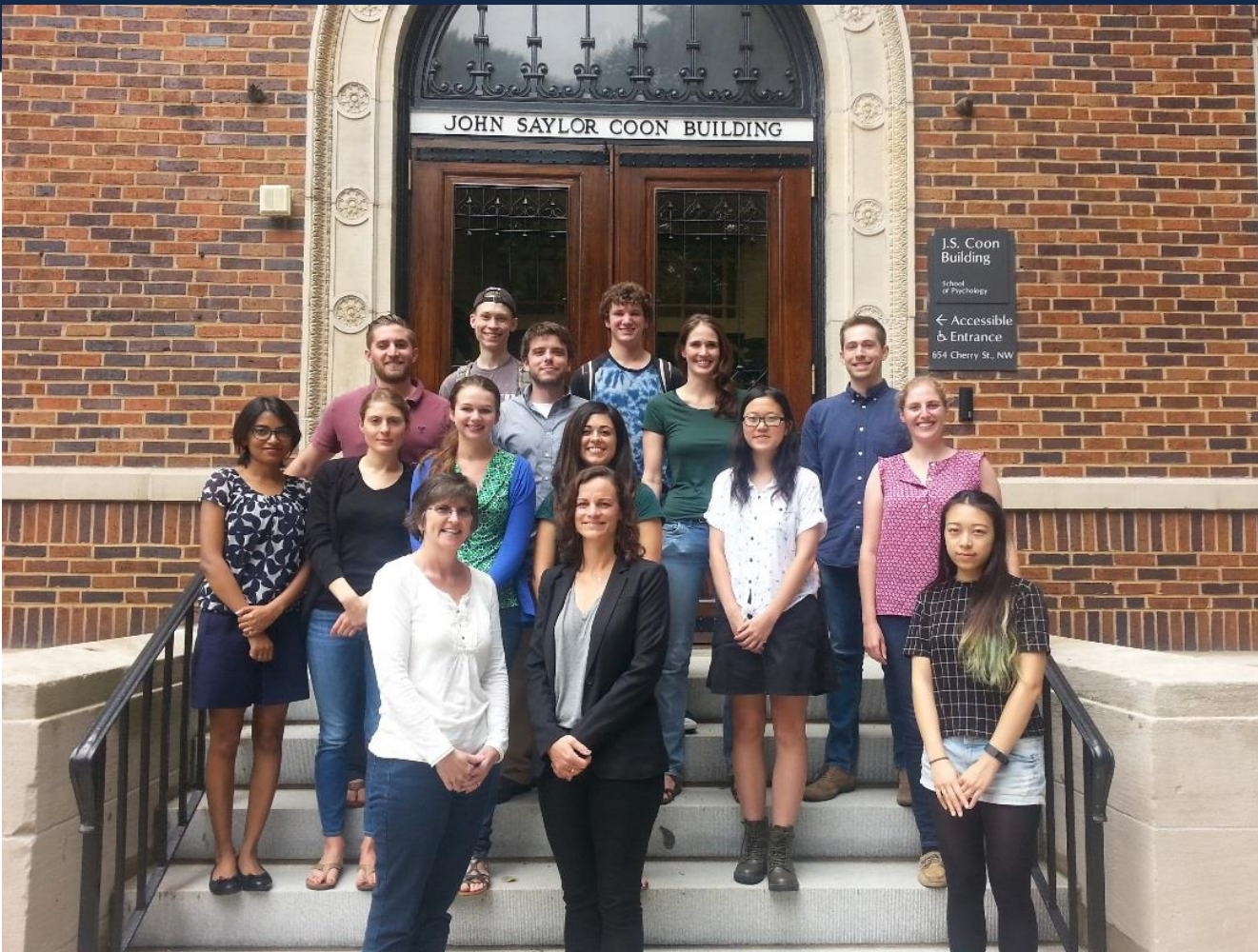
Center for Research and
Education on Aging and
Technology Enhancement
(www.create-center.org)

National Institute on Aging
(National Institutes of Health) PO1 AG017211



Technologies to Support
Successful Aging with Disability
(www.TechSage.gatech.edu)

National Institute on Disability, Independent
Living, and Rehabilitation Research
(Department of Health & Human Services)
Grant 90RE5016-01-00



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Dank U wel!

School of Psychology
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hfaging.org

Human Factors and Aging Laboratory

Current Projects

Social Connectedness

Memory Support

**Trust and Reliance
on Automation**

**Needs Assessment –
ADLs, IADLs, EADLs**

Usefulness & Ease of Use

Home

Acceptance & Long-term Adoption

**Human Factors of
Home Health Care**

Exergames

Technology

Pain Management

Human-Robotic Interaction

**Support for Social
Communication**

Wellness Management

Social Robotics

Health

Motivation and Self-Efficacy

Robotics

Subjective Well-being

**Communication with
Health Care Providers**

Telewellness Technologies

Personal Robots