User Centered Design and Development of a Game for Exercise in Older Adults

Belinda Lange, Ph.D.
Game-based Rehab Lab
Senior Research Associate
Institute for Creative Technologies
University of Southern California
Los Angeles, California

Rachel Proffitt, OTD, OTR/L
Game-based Rehab Lab
Clinical Researcher
Institute for Creative Technologies
University of Southern California
Los Angeles, California
Older Adults and Falls

- Balance relies on the visual, somatosensory and vestibular sensory systems
- Changes in these systems with age
- More than 1/3 of older adults experience a fall every year
- Falls are responsible for significant disability, reduced physical function and loss of independence
Current Methods to Reduce Falls

- Exercise
- Tai Chi
- Dancing
- Walking

- Adherence?
- Motivation?
- Level of Challenge?
ED FISCHER @ '08

Yes, yes, yes - now seriously - what can we do to improve our health?

1. Exercise
2. Exercise
3. Exercise
4. Exercise
5. Exercise
6. Exercise
7. Exercise
8. etc.
Tasks to improve and maintain balance should...

- focus on a specific targets derived from **data-driven assessment** to direct treatment
- be **adjustable in terms of difficulty level** from something simple for the client to accomplish, to a level representing normal performance
- be administered **repetitively and hierarchically**
- provide the client with **strategic feedback** as to the outcome of performance
- be **quantifiable** in order to assess progress
- have some **relevance** to real world function
- **motivate participation**!

**VIRTUAL REALITY GAME-BASED TECHNOLOGY IS IDEALLY SUITED TO MEET THESE REQUIREMENTS**
Challenges with Off-Shelf-Devices

Compensatory Movements

Level Difficulty

Graphics

Feedback

Data Management

Dynamic Difficulty Adjustment
Functional tasks (motor, sensory, cognitive) that need to be included in the game

Is there something that already exists? (off the shelf or developed in our lab: what technologies (hardware) is available and what games are available?)

Yes

No

FOCUS GROUP: What are the user’s thoughts about the current games? How do they interact with these games? What are the user’s thoughts about aspects that could be added to the game?

FOCUS GROUP: User’s thoughts on their impairment and associated therapy? User’s suggestions for game play characteristics, mechanics and goals?

GAME DESIGN and HARDWARE DESIGN: Depending on user feedback and requirements, hardware is designed and games are designed. These games are designed using the Iterative design process (outlined by Fullerton et al 2004). This iterative design process involves input from user groups throughout the process.

USABILITY STUDIES: Users provide feedback about all aspects of the hardware and games.

REVISIONS: Games and hardware revised based on user feedback.

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CLINIC BASED ASSESSMENT
Focus Groups

- Older Adults in the Center for Successful Aging Exercise Programs (California State University - Fullerton)
  - Focus group: 15 participants
    - Male n=6 aged 67 (± 7.5)
    - Female n=9 aged 53 (± 5.5)
Current Activities/Participation

- Exercise classes at Fullerton
- Olly program at Fullerton - classes for mental engagement
- Walking: alone, with friends and/or dogs
- Playing/babysitting grandchildren
- Volunteer activities - American Cancer Society, Boy Scouts
- Part-time work
Motivation

- Seeing friends the same age/younger start “going downhill”
- The social atmosphere of the exercise classes provide support
- Want to live long enough to see grandchildren hit life milestones
- Can notice the benefits of exercise- feel worse when reduce exercise
- “Even though I am the same (physical health) after 1 year, that is good because I’m 1 year older!”

Female, 75
Barriers to Activity

• Capacity
  – Injury/ illness

• Motivation and self – efficacy
  – Slowing down- takes longer to do things
  – Can’t accomplish what want to do during the day

• Time commitments

Benefits of Activity

• Capacity
  – Maintain cognitive abilities
  – Feel better physically and mentally
  – Pain reduction

• Motivational enhancements
  – Social interaction
What changes have occurred in the last 5 years?

- **Capacity**
  - hip replacements, knee replacements, falls, fibromyalgia, cancer, stroke

- **Two distinct groups:**
  1) Decreasing Capacity
     - Noticing reduction in physical and cognitive abilities: slowing down
  2) Increasing Capacity
     - Improved since starting exercise classes

What do you see happening in the next 5 years?

- **Capacity**
  - Continue to see reduction in physical and mental abilities

- **Motivation**
  - Increased fear of: not being able to exercise, falling, joints wearing out
What games do older adults play?

- Logic puzzles, Crossword puzzles, Sudoku
- TV Quiz shows: Jeopardy, Wheel of Fortune
- Board Games: Scrabble, Monopoly
- Card games: Uno, Bridge, Poker
- PC games: Bridge, Words with Friends
- Very few have played video games!

Perception of current video games

- Intensity is too high
- Difficulty understanding how to play/perceiving who they are on the screen
What do participants want to see in a game?

- **Include a mental challenge**
- **Type of Game**
  - Puzzle games
  - Travel/adventure games
  - Historical games
  - Music from their era “The music makes me feel as though I have something in common with these other people… a sense of nostalgia”
- **Feedback**
  - Progress
  - Accomplishments/success
- **Instructions**
  - Make initial steps/set-up clear and easy to use
Introducing Kinect for Xbox 360

You are the controller. No gadgets, no gizmos, just you!

Kinect brings games and entertainment to life in extraordinary new ways without using a controller. Imagine controlling movies and music with the wave of a hand or the sound of your voice. With Kinect, technology evaporates, letting the natural magic in all of us shine.
Microsoft Kinect

Field-of-view: 58 degrees horizontal and 45 degrees vertical

Resolution: 640x480 at 30 frames per second.
Flexible Action and Articulated Skeleton Toolkit (FAAST) (Suma, Lange, Rizzo & Bolas)

- How can we build a middleware with a flexible user interface to allow access to wider population of programmers?
  
- Software: OpenNI and PrimeSense

- Hardware: PrimeSensor or the Microsoft Kinect sensors

- FAAST is middleware to facilitate integration of full-body control with games and VR applications

- FAAST includes a custom VRPN server to stream the user’s skeleton over a network, allowing VR applications to read the skeletal joints as trackers using any VRPN client
User Testing Protocol

- Overall perception of the game
- Overall perception of the technology
- Instructions
- Game elements
- Comparison to current exercise program
- Game Ideas and Future use of game
User Testing Participants

- Total n = 19
- Male n = 7
- Female n = 12
- Age 55-92 years
- 9/19 participated in both focus group and user testing
- 2 iterations of user testing to develop final prototype