Tailored Coaching System with Embedded Cognitive & Physical Assessment
Interactive Exercise Intervention for Older Adults in the Home

Hagler

Designed

Physical Adherence

Increased cognitive load slows motor speed

Tailored

Cognitive Dynamic

Motor speed predicts cognitive

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Motivation

Assessing Physical Function via Interactive Exercise Video

Exercise enhances mobility, flexibility, and balance in seniors. Exercise that improves strength, flexibility and posture, will in turn help with balance, coordination, and reducing the risk of falls. Strength training also helps alleviate the symptoms of chronic conditions such as arthritis.

Exercise reduces the impact of illness and chronic disease. Among the many benefits of exercise for seniors include improved immune function, better heart health and blood pressure, better bone density, and better digestive functioning. Seniors who exercise also have a lowered risk of several chronic conditions including Alzheimer’s disease, diabetes, obesity, heart disease, osteoporosis, and colon cancer.

Exercise improves sleep. Poor sleep is not an inevitable consequence of aging and quality sleep is important for overall health and functioning. Exercise often improves sleep, especially for seniors.

Exercise boosts mood and self-confidence. Endorphins produced by exercise can reduce feelings of sadness or depression. In addition, being active and feeling strong naturally helps seniors feel more self-confident.

Exercise improves cognitive functioning. Exercise benefits cognitive function in several ways, including increasing blood flow to the brain and in increasing brain plasticity. Research has shown that several types of exercise improve seniors’ cognitive scores.

Exercise helps seniors maintain or lose weight. As metabolism naturally slows with age, maintaining a healthy weight is a challenge. Exercise helps increase metabolism and builds muscle mass, helping to burn more calories.

Cognition and Motor Function Are Intertwined

• Increased cognitive load slows motor speed
• Motor speed predicts cognitive decline

Approach

Software platform for delivering health behavior coaching interventions to the home:

Tailored interventions for physical exercise, sleep, socialization and cognitive exercise for seniors.

• Adherence and outcomes based on sensor data (activity, computer interactions, etc.)

• Designed to facilitate a health coach in managing a large population.

Basic Science Contributions

• Dynamic User Model for tailoring interventions
• Embedded Assessments / Computational Models
• Cognitive – from walking speed, keyboard & mouse movements, and cognitive computer games
• Physical Function – extracting measures of balance, flexibility, strength and endurance in real time from images of users during exercise

Design an automated interactive exercise system:
• Video with a selection of prescribed chair exercises featuring our physical therapist
• Kinect camera used to obtain skeleton representations of the user’s movements during the exercise in the home
• Compare goal movements to actual movements to generate automated feedback

Develop automated assessment methods to measure and monitor balance, flexibility, and strength

Example: Inference of Balance
For the shallow squat exercise, the features used for defining balance are based on (1) the position of the left hip relative to the left foot, (2) the position of the right hip relative to the right foot, (3) the position of the left shoulder relative to the left foot, and (4) the position of the right shoulder relative to the right foot. Balance is then defined as the stability of the center of mass and the minimum jerk trajectory.

Interactive Video Exercise

Dynamic User Model for Health Coaching

By monitoring keyboard and mouse interactions during use of our adaptive cognitive computer games, as well as during routine computer use, we are able to extract measures of motor speed, executive function, divided attention, and working memory. Because we measure frequently, we can look for trends and variability in these measures. This offers the potential for early diagnosis and feedback for interventions.

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