Do Older Adults Prefer "Smart" Lighting Cues in a Darkened Home Environment?

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Abstract

Background

Falls are one of the most common accidents amongst the aging population and frequently lead to placement in long-term care facilities. [1-4] The chance of a fall increases when an older adult navigates in the dark.[5]

The TAFETA Project for Older Adults Research Team has installed two smart lighting technologies in its living laboratory, called the TAFETA Smart Apartment. These technologies are: (1) a Liteed Pathway™ consisting of illuminated strips and (2) an Austco fading light solution, which includes the Liteed Pathway™ as well as fading bathroom and bedside lights. Both systems work with sensors to provide visual cues to individuals traveling from the bedroom to the bathroom in the dark; this high-traffic area is a common location of falls.[5]

This study investigates user acceptance of both technologies by giving participants an opportunity to rate these systems against standard home lighting and communicate their preference.

Method

36 consenting in- and out- patients from rehabilitation (≥ 50 years) were assigned to one of six randomly-determined groups to test the Liteed Pathway™, the Austco fading light solution, and standard room lights. Pre- and post-trial interviews, including Likert scale choices and free text comments were used to record the preference of each visual aid.

Results

18 in-patients and 18 out-patients, age range 54 to 93, primarily diagnosed with stroke and orthopedic impairments. 71% of patients preferred the Austco fading light solution (p<0.001). 72% of in-patients and 47% of out-patients were willing to modify their home with the technologies. While in-patients were more willing than out-patients to modify, this difference did not achieve statistical significance. However, older sub-groups were less willing to modify their homes than their younger counterparts.

Discussion

Older adults are willing to adopt smart technologies, especially when the product serves a practical function like illuminating a room. Smart technologies designed to facilitate a clinical function should be designed with the users' needs in mind, which will maximize their acceptance in the marketplace and promote "aging in place."

Introduction

- Approximately 30% of people aged 65 years and older suffer from falls annually, with 10-15% of these falls resulting in major injuries, such as fractures.[1-3]
- Most falls occur in the home with more than one-third occurring in the bathroom and bedroom.[4]
- Smart lighting technologies, which are triggered by activities of daily living, may show promise in helping to prevent falls by directing a person from the bed-to-bathroom area in a darkened environment.
- A study of the home monitoring of heart failure was shown to reduce hospital readmission rates and patient acceptance of the technology used was high.[7]
- As well, a recent national report shows that technology acceptance amongst the aging population continues to rise, with Internet usage in households headed by seniors increasing by 20% from 1997 to 2003.[8]
- Research also shows that the acceptance of technology decreases with advancing age.[9]
- This pilot study evaluates user preference of (1) Liteed Pathway™ illuminated strips and (2) the Austco fading light solution when compared to standard room lights.
- The team hypothesizes that: (1) participants will find orientation and navigation with pathfinding cues easier than without such cues and (2) the Austco fading bathroom and bedside lights will be preferable to Liteed Pathway™ illuminated strips (due to the increased brightness).

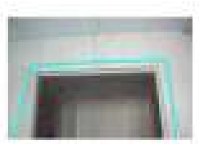
Technology

The Liteed Pathway™ illuminated strips and the Austco fading light solution work in conjunction with the bed-based occupancy sensor (mat) and motion sensor. The mat, shown in the photo to the lower left, is placed under the mattress.

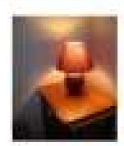
When the older adult gets out of bed, a signal is sent to the Liteed Pathway™ and the strips on the bedroom door and in the bathroom light up. A separate bathroom ceiling light is also activated.

The patient follows the visual cues to the bathroom and upon return, the motion sensor activates the Austco fading light solution, which illuminates the bedroom.

When the patient lies down on the bed, the pressure on the mat de-activates the Austco fading lights, which gradually dim. The pressure also turns off the Liteed Pathway™ illuminated strips and the bathroom light.



Liteed Pathway™ Illuminated Strips



Austco Fading Light Solution

Bed-Based Occupancy Sensor (Mat)

Motion Sensor

Location

- TAFETA Smart Apartment
  Élisabeth Bruyère Health Centre, SCO Health Service
  Ottawa, Canada

Participants

- 36 patients from the stroke, geriatric and neuro-musculo-skeletal programs, and the geriatric Day Hospital
- 50 years of age and older; able to consent in French or English
- Ambulatory with a functional independence measure score ≥ 5 on bed transfer or equivalent
- Legally blind participants excluded

Ethics Review

- Approved by SCO Health Service Research Ethics Board

Study Design

- 45-minute visit to the TAFETA Smart Apartment
- Night simulation by means of closed doors and covered windows
- Simulation of eight time trips to the bathroom testing three conditions: Liteed Pathway™ illuminated strips, Austco fading light solution, and standard room lights
- Participants assigned to one of six randomly determined test condition sequences

Data Collection and Analysis

- Pre-test interviews to obtain health information and discuss home lighting and bathroom visits
- Post-test interviews to acquire participants' preference of lighting system
- Categorical (e.g. yes/no) data analysis using chi-squared tests
- Ordinal data (e.g. 5-point Likert scale)
- Open-ended questions

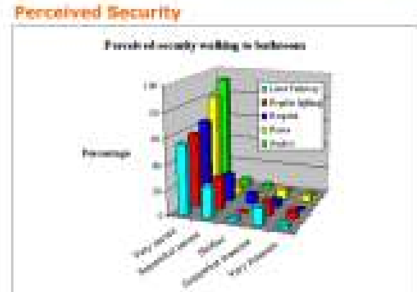
Results

Sample Overview

IN-PATIENTS
- N = 18
- 6 male, 12 female
- Mean age = 78.0 (62-91)
- Mean hospital stay = 11.4 weeks
- Top three reasons for stay:
  - Fracture = 6 (33%)
  - Stroke = 6 (32%)
  - Joint repl. = 2 (11%)

OUT-PATIENTS
- N = 18
- 8 male, 10 female
- Mean age = 74.8 (54-93)
- Mean hospital stay = 14.2 weeks
- Top three reasons for stay:
  - Stroke = 11 (61%)
  - Falls = 2 (11%)
  - Other = 3 (17%)

Perceived Security



Research Question: When you got up to go to the bathroom, how secure did you feel in your ability to walk safely to the bathroom and back?

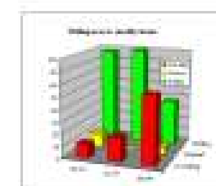
- Patients felt most secure with the Austco fading light solution (92% secure).
- Patients felt least secure with the Liteed Pathway™ illuminated strips and the standard room lights (56% and 58% secure, respectively).

Overall Preference

Research Question: During your visit, you tested three different light sources: the illuminated strips, the gradual bathroom and bedside lights, and the regular room lights. Which of these did you prefer?

- 71% of patients preferred the Austco fading light solution to the Liteed Pathway™ illuminated strips and standard room lights.
- Statistically, this is highly significant ($\chi 2 = 21.45$, $df=2$, $p<.001$).
- The preference was stronger in in-patients than out-patients.
- Two out-patients expressed no preference.

Willingness to Modify Home



Research Question: How willing would you be to make adaptations, such as installing these pathfinding cues, to your home?

- 60% of decided participants were willing to modify their homes. More in-patients than out-patients expressed a willingness to modify their homes, but this did not reach statistical significance. Willingness to modify the home decreased as a function of age, especially in participants over 80 years of age.

Discussion

- Our study investigated a typical frail older adult population. In this case in- and out-patient rehabilitation clients.
- The study results confirmed our hypotheses that:

  (1) participants would find orientation and navigation with pathfinding cues easier than without such cues and

  (2) the Austco fading bathroom and bedside lights — the brightest of the three lighting scenarios tested — would be the preferred option.
- Except for the oldest adults, older adults are generally willing to adopt smart technologies for use within their homes — especially when the technology has a noticeable benefit.
- Smart technologies, like the Austco fading light solution, can also be used for clinical purposes. For example, integrating motion detectors into the lighting system can lead to the early identification of mobility impairments and eventually lead to the development of a system that may reduce falls.
- We believe that clinical technology designed with a practical function is more likely to be adopted by its users.
- The TAFETA Smart Apartment Project for Older Adults Research Team is currently researching a broad range of smart technologies, which address a variety of clinical issues.
- By considering user acceptance within each smart technology's design, we will increase our chance of success in the marketplace, improve our ability to meet each patient's medical needs, and ultimately further our mandate to help older adults "age in place."

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Acknowledgements

The TAFETA Research Team thanks the occupational therapists and rehabilitation program staff at the Élisabeth Bruyère Health Centre led by Mrs. Liliane Locke.

Thank you also to Tactex Controls Inc. and Austco systems for equipment donations as well as the engineering students at Carleton University for their hard work.

As well, we appreciate the generous funding provided by the University of Ottawa's Faculty of Medicine Summer Research Studentship Program.