Impact of executive function on gait in older adults with cognitive impairment.

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BACKGROUND :
The modification of gait parameters shown in older adults in a dual-task (DT) exercise could also serve to characterize impairment of executive functions (EF).

AIM :
The objective is to determine the influence of the EF in a complex dual-task exercise on walking in aging subjects with or without cognitive decline. Our hypothesis is that we can differentiate MCI from healthy subjects by a complex DT.

METHODS :
Population
15 young people (Y) and 18 older adults (O) autonomous volunteers with a good social level were recruited for study. Adult participants without any pathology likely to influence walking, underwent psychometric tests (Mini Mental State Examination (MMSE), Frontal Assessment Battery (FAB), Wechsler Intelligence Scale (WAIS), Trail Making test (TMT), Stroop, "The 5-words, Geriatrics Depression Scale (GDS), Instrumental Activities of Daily Living (IADL). Finally, there were 15 MCI patient.

Table 1. These patient have been split according to Petersen’s criteria1 into several MCI groups.

<table>
<thead>
<tr>
<th>MCI classification</th>
<th>young</th>
<th>healthy older</th>
<th>borderline MCI</th>
<th>Amnestic MCI</th>
<th>non-amnestic MCI executive impairment only</th>
<th>multiple-domain amnestic</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMT</td>
<td>Y</td>
<td>O</td>
<td>Y</td>
<td>O</td>
<td>Y</td>
<td>O</td>
</tr>
</tbody>
</table>

*borderline* MCI (IMCI) as they don’t have a mild cognitive decline but their performances to the EF tests are limits of the pathological threshold.

Protocol
In DT, the gait parameters were recorded by GAITRite® system on Walking Trail-Making Tests (W-TMT) similar to the Persad protocol1. Three walkways of increasing complexity were used: W-TMT N with numbers only, W-TMT A with numbers and distractors, W-TMT B where the participants choose a path connecting alternatively a number to a letter in an upwards progression.

Figure 1. Illustration of the experimental condition in the W-TMT.

W-TMT N

W-TMT A

W-TMT B

Statistical analysis
The statistical analysis used was a cluster analysis (Ward method [28], Euclidian distance) based on 15 independent variables (velocity, cadence, cycle time, step length, double-limb support percentage (% DS) (percentage of time spent with both feet in contact with the ground). The meaningful differences between the groups were calculated by an ANOVA with one factor followed by a PostHoc Fisher test (Statistica Statsoft ©).

RESULTS :
Figure 2. Gait pattern Dendrogram of the W-TMT. The figure is read from the bottom where the individual trials are listed, in three families, to where all gait trials are grouped into a single family. The optimal number of clusters is three, confirmed by the calculation of the R-ratio (Hartigan 1975).

G1 is made of 17 older participants (5 O, 12 Y), 2 are healthy participants, H), 6 are MmC1, 3 are nMCl, 5 are not MCI and 1 is MCI.

G2 is made of 15 subjects (14 Y, 1 O), 6 are H and 1 is MCI.

G3 is made of 15 MCI participants suffering from EF impairments.

G2 is made of 15 MCI participants suffering from EF impairments.

G3 is made of 15 MCI participants suffering from EF impairments.

G3 is made of 15 MCI participants suffering from EF impairments.

Table 2. Demographic and clinical characteristics of study participants stratified by cluster results.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Subject group</th>
<th>G1 (n=17)</th>
<th>G2 (n=15)</th>
<th>G3 (n=18)</th>
<th>p value</th>
</tr>
</thead>
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<tr>
<td>Age (y)</td>
<td>77±7.5</td>
<td>62±6.2</td>
<td>57±7.9</td>
<td>p&gt;0.000, G1=G2=G3</td>
<td>68±8.8</td>
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<tr>
<td>Female (%)</td>
<td>53 (3)</td>
<td>50 (2)</td>
<td>50 (2)</td>
<td>p&gt;0.000, G1=G2=G3</td>
<td>50 (2)</td>
</tr>
<tr>
<td>Cognitive Test</td>
<td>MMSE</td>
<td>27±6.1</td>
<td>28±6.1</td>
<td>29±6.1</td>
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<td>FAB</td>
<td>13±1.7</td>
<td>13±1.7</td>
<td>13±1.7</td>
<td>ns</td>
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<tr>
<td>WABS (digit span forward and backward)</td>
<td>100±4.0</td>
<td>100±4.0</td>
<td>100±4.0</td>
<td>p=0.000, G1=G2=G3</td>
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<tr>
<td>Stroop</td>
<td>21±5.3</td>
<td>21±5.3</td>
<td>21±5.3</td>
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<tr>
<td>TMT A (s)</td>
<td>43±10.6</td>
<td>49±10.9</td>
<td>42±10.9</td>
<td>p=0.005, G1=G2=G3</td>
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<tr>
<td>TMT B (s)</td>
<td>96±37.9</td>
<td>105±41.7</td>
<td>106±37.9</td>
<td>p=0.000, G1=G2=G3</td>
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<tr>
<td>Delta TMT (s)</td>
<td>56±37.2</td>
<td>56±37.2</td>
<td>56±37.2</td>
<td>p=0.000, G1=G2=G3</td>
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<tr>
<td>5 Words of Digits</td>
<td>17±5.2</td>
<td>17±5.2</td>
<td>17±5.2</td>
<td>p=0.000, G1=G2=G3</td>
<td></td>
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<tr>
<td>Clock-drawing test</td>
<td>6±9.7</td>
<td>6±9.7</td>
<td>6±9.7</td>
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</tbody>
</table>

Figure 3. Results of analysis of variance (ANOVA) on double-limb support percentage in each cluster group for each walking test condition.

DISCUSSION / CONCLUSION :
The analysis of the gait parameters reveals three groups (figure 2) which are different on the age between G2 and G1, G3 and on the cognitive performances between G1 and G2, G3 (table 2). It is only in the most complex condition (W-TMT B) that we observe a significant difference between healthy subjects (G3) and dysexecutive MCI (G1).

This non-invasive and low-cost complex DT enables to determine at an earlier stage than the usual psychometrics paper-pen tests older patients likely to develop cognitive impairments.

BIBLIOGRAPHIE :
INTRODUCTION

Being physically active (PA) at a high age is important for one’s health. And high amounts of sedentary behaviour (SB) are associated with increased risk of morbidity and mortality (e.g. obesity, cancer and cardiovascular diseases), regardless of time spent being active (moderate- to vigorous-intensity physical activity (MVPA)). Although it is contradictory, an individual can be simultaneously very sedentary and sufficiently physically active in the MVPA levels.

Awareness of sedentary behaviour is important. It can aid the aging and their health professionals to determine suitable lifestyle changes for the elderly person. This information can also be used in ambulatory coaching systems and mHealth applications.

The aim of my study is to improve mobility of the elderly by monitoring PA and SB using subjective and objective tools.

RESEARCH QUESTIONS

- How can we measure PA with a hip mounted sensor?
- What are the PA & SB patterns of elderly during free living?
- Which measures of PA & SB are most relevant in mobility assessment of elderly?

DEFINITIONS

PHYSICAL ACTIVITY (PA)

“Any bodily movement produced by the contraction of skeletal muscles that result in a substantial increase in caloric requirements over resting energy expenditure” (ACSM)

PA guidelines often refer to time spent in moderate- to vigorous-intensity PA: MVPA. Inactive is the term to describe those who are not meeting the PA guidelines. (M. Tremblay 2012)

SEDENTARY BEHAVIOUR (SB)

“Any waking behaviour characterised by an energy expenditure < 1.5 METs while in a sitting or reclining posture.” (M. Tremblay 2012)

METHODS

SUBJECTIVE PA & SB

Self-perceived physical activity (questionnaires, e.g. PASE) and value based interviews (incl. perceived barriers and facilitators to be physical active).

OBJECTIVE PA & SB

Hip-worn 3D accelerometer to measure activity patterns during daily living.
Development of nursing competencies in eHealth to enhance the use of home telehealth

Introduction. Within the next decade the number of care professionals (in The Netherlands) will no longer be sufficient to deal with the increasing demand for care. eHealth, for example screen-to-screen contact instead of regular face-to-face, offers older adults a solution to age in place and is claimed to be a solution for the increasing demand for care. Despite the apparent positive effects of this technology, there are several barriers to implementation. One of the main barriers is largely caused by the lack of knowledge and skills of health care professionals how to use this new technology [1]. The primary aim of this doctoral research is providing evidence based knowledge, skills and competencies required for the use of eHealth technologies with patients living at home.

Phases and disciplines in the PhD project

<table>
<thead>
<tr>
<th>Phase 1</th>
<th>Phase 2</th>
<th>Phase 3</th>
<th>Phase 4</th>
<th>Phase 5</th>
<th>General Discussion</th>
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<tr>
<td>Gerontechnology</td>
<td>Medical education</td>
<td>Gerontechnology &amp; Medical education</td>
<td>Medical education</td>
<td>Gerontechnology &amp; Medical education</td>
<td>Gerontechnology &amp; Medical education</td>
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<tr>
<td>Exploration of predictors of the use of eHealth by care professionals and older adults</td>
<td>Development of eHealth competency framework for nurses</td>
<td>Examining the impact of education on the willingness of nursing students to use eHealth</td>
<td>Examining the impact of eHealth competencies on ‘behavior’ of nurses and / or patient satisfaction</td>
<td>Ethical considerations: exploring the impact of shifting from face-to-face care to ‘care at distance’ on the nurse-patient relationship</td>
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</tbody>
</table>

Survey – Multiple regression analysis | Delphi-Study | One group pretest–posttest design | Within Group Design | In-Depth Interviews | Literature Review |

Nurses working in a home care organization and older adults living independently | Nurses / clients using eHealth, technicians, and teachers – bachelor of nursing | Students – bachelor of nursing | Nurses and clients using eHealth in a home care organization | Nurses and clients using eHealth | Cochrane, CINAM, PubMed, Science-Direct, Scopus |

Methods and results

The Unified Theory of Acceptance and Use of Technology (UTAUT) has been used as a starting point ([2,3] in phase 1. Theories of Entrustable Professional Activities (EPA’s) [4] and medical competence will play a central role in phase 2, 3 and 4. During the different phases a mixed set of research designs will be used, from quantitative to qualitative and mixed methods.

Results phase 1: In our sample of nurses, willingness to use home telehealth was predicted by its (a) perceived usefulness to the client ($\beta = 0.435, p < 0.001$), (b) effort expectancy ($\beta = 0.280, p = 0.001$), (c) social influence ($\beta = 0.216, p = 0.013$), and (d) cost expectations ($\beta = 0.236, p = 0.004$).

On the left in Figure 1, seven possible predictors of nurses’ willingness to use home telehealth are shown. Four predictors (marked in red) appeared to have a significant effect. We distinguished determinants based on the UTAUT [3] and additional determinants that were tested. Additionally, feelings related to the use of home telehealth were explored, as shown in the top right.

Discussion

Home telehealth, signifying a transition from face-to-face care to screen-to-screen care, may contrast with the expectations with which health care professionals begin their career. Dutch health care professionals feel valued when they help patients out of bed, change their clothes, help them eat, or assist them in taking a walk (activities of daily living). The fear of losing this interaction may create a barrier for the use of home telehealth by health care professionals. Therefore, more research is needed to gain an understanding of the quality of contact when nurses provide ‘care at distance’. Furthermore, the actual effectiveness of educating nurses and / or nursing students based predictors from phase 1, has to be examined. For many years, studies in the literature have emphasized the urgency of eHealth education. Therefore, the slow development of eHealth education is remarkable. More evidence on the competencies and skills required for the use of home telehealth is needed to increase the self-efficacy of nurses in applying home telehealth interventions. When nurses become better equipped to work with home telehealth, they will improve the quality of life of older adults by supporting aging in place.

References

VALIDITY AND INTER-TESTER REPRODUCIBILITY OF ACTIGRAPHY IN THE ELBOW RANGE OF MOTION MEASUREMENT IN GERONTOLOGY

INTRODUCTION
Musculoskeletal system deterioration among the aging is a major reason for loss of autonomy and directly affects quality of life of the elderly. Articular evaluation is part of physiotherapeutic assessment. It helps in establishing a precise diagnosis and to plan accurate therapeutic measures. References instruments are reliable but not easy to use for some joints.

OBJECTIVE
The main goal of our study was to determine validity and inter-tester reproducibility of an actigraph (the Motion Pod) associated with a specific software (Bio Val) in the elbow passive range of motion measurements in geriatrics (figure 1).

MATERIAL and METHOD
Our study was an open-monocentric randomized study (figure 2) comparing actigraph to inclinometer. The validity of the MP-BV was evaluated against an inclinometer by calculating the proportion of measurements for which the difference between the two tools is below 10 degrees for the four movements (flexion, extension, pronation, supination). We compared the measurement time between the MPBV and the inclinometer. Finally the acceptability of the MP-BV was assessed using visual analog scales.

RESULTS
Among the 84 patients included in this study, measurement data were available for 77 (91.7%). Characteristics of the patients with missing data for analyses did not differ significantly from analyzable patients. Mean age was 83.5 ± 6.1 years (range 68 - 101), 46 (54.7%) were women and 38 (45.3%) men resulting in a sex-ratio of 1.2.

Measuring validity: Valid measures percentage for the three movements with the MP-BV was 23.4% [13.9-32.8]. This percentage was 59.7% [49.2-70.5] for the flexion, 68.8% [58.4-79.5] for the pronation and 62.3% [51.2-73.1] for the supination.

Inter-tester reproducibility: The ICCs were 0.15 [0.07-0.73] for the flexion, 0.46 [0.27-0.98] for the pronation and 0.50 [0.31-0.98] for the supination. For those movements, concordant measures percentage was respectively 53.2% [42.1-64.4], 57.1% [46.1-68.2] and 53.2% [42.1-64.4].

Measuring time: Examination mean duration was significantly longer with the MP-BV than with the inclinometer, respectively 117.4 (±26.9) seconds and 104.4 (±34.0) seconds, p<0.0001.

Acceptability: There was no significant difference between both instruments regarding patient comfort, with a mean visual analog scale (VAS) for the MP-BV of 9.21 (±1.10) versus 9.26 (±0.99) with the inclinometer. Results were the same regarding the physiotherapist’s acceptance to the instrument with, respectively, a mean VAS of 7.88 (±1.97) and 7.70 (±1.70).

Regarding the ease of use, mean VAS was 8.55 (± 1.21) for the MP-BV against 7.13 (±2.54) with the inclinometer (p<0.0001). Results were the same regarding the data export, with a mean VAS of 8.76 (±1.44) and 7.24 (± 2.7) (p<0.0001).

CONCLUSION
This research shows the convenience of the MP-BV in terms of ease of use and of export of measured data. However, this instrument seems less reliable and valuable compared to the reference instruments used to measure elbow range of motion used in gerontology.

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Gerontology, Rehabilitation, validation, Inter-tester reproducibility, Inclinometer
Interactive System For Older Adults With Dementia
Az@Game Project ¹
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INTRODUCTION

Context ✓ In 2010, Worldwide, 3.6 million people live with dementia. Every year, 7.7 million new patients appear. In 2012 in France, 850,000 people were affected by Alzheimer’s disease.
✓ Az@Game project offer a ludic environment. This is a Serious Game that can support a person affected by Alzheimer’s disease within an hospitalization and home care.

Motivation ✓ The proposed environment in the project requests many interactions between the game and the patient.
✓ The studied patient are elderly person and living independently in their own house. The question arises on their motivation to participate voluntarily in the game. How can we stimulate them?
✓ Seniors often have difficulties with the adoption of the new technologies and their uses. How will the system interact with the patient?

Objectives ✓ Designing an interactive system which’s able to recognize activities of patient for deciding the best moment to stimulate them.

ARCHITECTURE

• The system consists of two components :
  ✓ Activity Recognition
  ✓ Interaction

• Activity Recognition base mainly on the SUP framework of Inria STARS team. Running on Linux, this component use ASUS camera to detect, track objects on the scene and recognize their activities.
• It sends all of recognized activities to other component through a TCP Socket.
• Interaction is an interface containing a scene and an avatar in 3D, developed by Unity game engine. In terms of activities sent for other component, the avatar will interact with the patient in different scenarios.
• When the patient accept to participate to a game session, the interface will run the Serious Game equipped Kinect Camera.

MODELING

CONCLUSION AND PERSPECTIVES

✓ We developed an interactive system which is able to stimulate a Alzheimer’s patient for participation in a Serious Game.
✓ The integral system should run in only one computer.
✓ An authentication component should be added.
✓ We want to assess the concentration of patient during the game session in order to assist them.

Partners : INRIA, GENIOUS Interactive, CoBTeK, IDATE

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BACKGROUND
Within the last years, the use of new technologies for the support of elderly people and in particular dementia patients motivated academic and industrial research. Most available prototypes have been developed for monitoring purposes such as fall detection or gait analyses relying on wearable, environmental or video sensors. We investigated the use of a video monitoring system for event recognition for the assessment of Instrumental Activities of Daily Living (IADL) in dementia patients given the fact that it represents a major challenge in clinical practice.

MATERIAL AND METHODS
Participants (20 healthy elderly subjects, 20 Mild Cognitive Impairment and 15 Alzheimer patients) had to carry out a 15-minute standardized scenario consisting of several IADLs such as preparing a pillbox or making a phone call. During this time, they were recorded by a 3D video cameras capturing all their activities in the room. After the recording session, data was processed by a platform of Video Signal analysis in order to extract kinematic parameters detecting the activities undertaken by the participant and assessing their performance quality. We compared our automated activity quality prediction as well as cognitive health prediction with direct observation annotation and neuropsychological assessment scores.

RESULTS
We obtained statistically significant correlation between direct observation scores and predicted activity quality. With an accuracy of 79% performance quality of the participants was classified correctly. The accuracy for the diagnosis (cognitive health) classification based on the gathered video analyses data was at 68%.

CONCLUSION
The results suggest that it is possible to automatically quantify the task quality of IADL activities and perform its assessment with the help of automatic video analyses if learning algorithms are appropriately trained. Improvement of autonomy assessment: Using pharmacy basket, Reading, Using phone, Using office desk

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<th>Overall</th>
<th>Sensitivity</th>
<th>Precision</th>
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<table>
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